Washington County, Utah Construction Design Standards

Special Thanks To:

Santa Clara City
Washington City
St. George City

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U N D E R C O N S T R U C T I O N

TABLE OF CONTENTS

SECTION 1 INTRODUCTION

1.1 Introduction. 1-1
1.2 Definitions. 1-1
1.3 Bonds and Insurance. 1-6
1.4 Starting and Completing the Work. 1-6
1.5 Before Construction Begins 1-7
1.6 Preconstruction Conference 1-7
1.7 Approved Documents Intent 1-7
1.8 Amending and Supplementing the Approved Drawings 1-8
1.9 Underground Facilities Shown or Indicated 1-8
1.10 Underground Facilities Not Shown or Indicated 1-8
1.11 Reference Points and Monuments 1-9
1.12 Contractor's Responsibilities -Supervision and Superintendents 1-9
1.13 Safety and Protection 1-9
1.14 Site Emergencies 1-10
1.15 Authorized Variations in Work 1-11
1.16 Rejecting Defective Work 1-11
1.17 Warranty and Guarantee 1-11
1.18 Inspections and Observations 1-11
1.19 Contractor Employees 1-12
1.20 Historic, Archaeological or Paleontological Discoveries 1-12
1.21 Working Hours 1-12
1.22 Uncovering Work 1-12
1.23 County's Representative May Stop the Work 1-12
1.24 Correction or Removal of Defective Work by Contractor 1-13
1.25 One Year Correction Period 1-13
1.26 Acceptance of Defective Work 1-13
1.27 Correction or Removal of Defective Work by Owner 1-13
1.28 Work Fully Completed 1-13
1.29 Final Inspection 1-14
1.30 Final Walkthrough 1-14
1.31 Final Acceptance 1-14
1.32 Suspension of Work 1-14

SECTION 2 GENERAL REQUIREMENTS

2.1 Introduction 2-1
2.2 Construction Drawings 2-1
2.2.1 General 2-1
2.2.2 Curb and Gutter, Drainage, Sidewalks and Streets 2-2
2.2.3 Sewer/Storm Sewer 2-3
2.2.4 Culinary Water 2-4
2.2.5 Secondary Water 2-4
2.2.6 Power 2-5
2.2.7 Detail Sheets 2-5
2.2.8 Grading/Erosion Control Plan 2-5
2.2.9 General Utility Location Information 2-6
2.2.10 Drawing Submittals 2-7
2.3 Inspection, Testing and Quality Control. 2-7
2.3.1 Requests for Inspection. 2-7
2.3.2 Construction Completion Inspection (Final Inspection) 2-7
2.3.3. Guarantee of Work 2-8
2.3.4 Quality Control Testing 2-8
2.3.5 Test Reports 2-9
2.4 Drawings of Record 2-9
2.5 Barricades and Warning Signs - Work Area Protection. 2-9
2.5.1 General Traffic Control Requirements 2-10
2.6 Cooperation with Utilities 2-11
2.7 Cooperation Between Contractors 2-12
2.8 Construction Stakes, Lines and Grades 2-12
2.9 Use of Explosives 2-13
2.9.1 General Blasting Criteria 2-13
2.10 Protection and Restoration of Property and Landscape 2-13
2.11 Survey Monuments. 2-14
2.12 Hazardous Materials Discoveries 2-14
2.13 Improvement Sequence 2-15

SECTION 3 DESIGN STANDARDS

3.1 Introduction 3-1
3.2 Street Design 3-1
3.2.1 Street Cross-section Standards 3-1
3.2.2 Roadway Network Design 3-1
3.2.3 Improvement Requirements 3-3
3.2.3.1 Curb, Gutter and Sidewalk 3-3
3.2.3.2 Driveways 3-3
3.2.3.3 Pavement 3-3
3.2.3.4 Cross Gutters 3-3
3.2.3.5 Handicap Ramps 3-4
3.2.3.6 Roadway Medians and Round-Abouts 3-4
3.2.3.7 Minimum Access 3-4
3.2.3.8 Drainage 3-4
3.2.3.9 Traffic Control Devices 3-4
3.2.3.10 Pavement Marking 3-4
3.2.3.11 Street Trees & Landscaping 3-4
3.2.3.12 Other Improvements 3-4
3.2.4 Technical Design Requirements 3-4
3.2.4.1 Street Grades 3-4
3.2.4.2 Intersections 3-5
3.2.4.3 Intersection Spacing 3-7
3.2.4.4 Maximum Design Volume 3-7
3.2.4.5 Cul-de-sac Streets 3-7
3.2.4.6 Sidewalks 3-7
3.2.4.7 Curb and Gutter 3-8
3.2.4.8 Design Speed 3-8
3.2.4.9 Clear Sight Distance at Intersections 3-8
3.2.4.10 Vertical Alignment 3-9
3.2.4.11 Safe Stopping Sight Distance 3-10
3.2.4.12 Horizontal Curves 3-10
3.2.4.13 Superelevation 3-10
3.2.4.14 Deceleration Lanes 3-11
3.2.4.15 Driveway Profiles 3-11
3.2.4.16 Alignment and Continuity - Off-site 3-12
3.2.5 Pavement Structural Design 3-13
3.2.6 Mail Boxes 3-14
3.2.7 Signs and Pavement Markings 3-15
3.2.8 Underground Water 3-15
3.3 Soil Study Guidelines 3-15
3.3.1 Geotechnical Report 3-15
3.4 Drainage and Flood Control Design 3-18
3.4.1 General Requirements 3-18
3.4.2 Design Criteria - Streets 3-19
3.4.3 Design Criteria - Storm Drains 3-20
3.4.4 Design Criteria - Culverts 3-21

3.4.5 Design Criteria - Bridges 3-21
3.4.6 Design Criteria - Channels 3-22
3.4.6.1. Open Channels 3-22
3.4.6.2. Man-made Channels 3-22
3.4.6.3 Natural Channel 3-23
3.4.7 Storage Facilities 3-23
3.4.7.1 Design Criteria 3-23
3.4.8 Floodplains 3-24
3.4.9 Erosion Control 3-24
3.4.10 Irrigation Ditches 3-25
3.4.10.1 Use of Ditches 3-25
3.4.10.2 Irrigation Company Approval 3-25
3.4.11 Water Quality Control 3-25
3.5 Sanitary Sewer Design 3-26
3.5.1 Design Flows 3-26
3.5.2 Minimum Size and Depth 3-27
3.5.3 Alignment 3-28
3.5.4 Service Connections 3-28
3.5.5 Manholes 3-29
3.5.6 Utility Clearances 3-30
3.5.7 Suspended Crossings 3-31
3.5.8 Pressure (Force) Mains 3-31
3.5.9 Connection Into Existing Systems 3-32
3.6 Culinary Water Design 3-32
3.6.1 Design Flow Pressure 3-32
3.6.2 Flow Design Criteria 3-33
3.6.3 Minimum Size and Depth 3-33
3.6.4 Valves and Hydrants 3-33
3.6.5 Pressure Reducing Valves 3-33
3.6.6 Fire Hydrant Spacing and Location 3-34
3.6.7 Fire Flow Requirements 3-34
3.6.8 Miscellaneous Water System Design Criteria 3-35
3.6.9 Network Hydraulic Analysis 3-37
3.6.9.1 When Required 3-37
3.6.9.2 Design 3-37
3.6.9.3 Submittal for Review and Approval 3-37
3.6.9.4 Miscellaneous 3-38
3.7 Secondary Water or Wastewater Reuse Irrigation System 3-39
3.8 Other Utilities Systems Design 3-39
3.8.1 Responsibility 3-39
3.8.2 Street Lights 3-39
3.8.3 Burial of Lines 3-39
3.8.4 Layout 3-39
3.8.5 Front Lot Line Systems 3-39
3.8.6 Quality Control 3-39
3.9 Traffic Standards 3-40

3.9.1 Access Control 3-40
3.9.1.1. General Requirements 3-40
3.9.2 Traffic Impact Studies 3-40
3.10 Survey Monumentation Standards 3-42
3.10.1 General Requirements 3-42
3.10.2 Monuments 3-42
3.10.3 Types of Monuments 3-43

SECTION 4 CONSTRUCTION STANDARDS

4.1 Introduction 4-1
4.2 Survey Requirements 4-1
4.3 Earthwork 4-1
4.3.1 Materials 4-1
4.3.1.1 Excavation 4-1
4.3.1.2 Subsoil Reinforcement 4-1
4.3.1.3 Backfill 4-2
4.3.2 Construction Methods 4-2
4.3.2.1 Construction of Embankments 4-2
4.3.2.2 Compaction of Earth Materials 4-2
4.3.2.3 Subgrade Preparation. 4-3
4.3.2.4 Construction of Nonstructural Fills. 4-4
4.3.3 Quality Control 4-4
4.3.3.1 Testing 4-4
4.3.3.2 Acceptance 4-4
4.3.4 Special Requirements 4-5
4.4 Pipeline Construction 4-5
4.4.1 Materials 4-5
4.4.1.1 Sewer Pipe and Fittings 4-5
4.4.1.2 Storm Drain Pipe 4-7
4.4.1.3 Sewer Manholes 4-8
4.4.1.4 Water Pipe and Fittings 4-11
4.4.2 Construction Methods 4-19
4.4.2.1 Control of Ground Water 4-19
4.4.2.2 Excavation for Pipelines 4-19
4.4.2.3 Sheeting, Bracing, and Shoring of Excavations. 4-21
4.4.2.4 Blasting 4-21
4.4.2.5 Pipe Laying and Bedding. 4-21
4.4.2.6 Backfilling and Compaction 4-25
4.4.2.7 Trenches on Highways and Streets 4-27
4.4.2.8 Cleaning of Sanitary Sewer Lines 4-29
4.4.2.9 Cleaning and Disinfection of Water Systems 4-29
4.4.2.10 Special Requirements 4-29
4.4.3 Quality Control 4-30
4.4.3.1 Trench Backfill Moisture/density Testing 4-30
4.4.3.2 Sanitary and Storm Sewer Line Testing and Acceptance 4-31
4.4.3.3 Water System Testing and Acceptance 4-35

4.5 Roadway Construction 4-36
4.5.1 General Requirements 4-36
4.5.2 Construction Staking 4-36
4.5.3 Grade Control Systems 4-37
4.5.4 Geotechnical Investigation 4-38
4.5.5 Roadway Subgrade 4-38
4.5.5.1 Preparation 4-38
4.5.5.2 Tolerances 4-39
4.5.6 Subbase - Class I and Class II. 4-39
4.5.7. Untreated Roadbase - One Inch and Three-quarter Inch 4-40
4.5.8 Prime Coat 4-42
4.5.9 Tack or Fog Seal Coat 4-43
4.5.10 Dense-graded Asphalt and Reclaimed Asphalt Pavement (RAP) 4-44
4.5.10.1 Asphalt Design 4-44
4.5.10.2 Asphalt Cement 4-45
4.5.10.3 Shipment of Asphalt Material 4-46
4.5.11 Hydrated Lime for Asphalt Mixture 4-47
4.5.12 Aggregate 4-48
4.5.13 Storing, Mixing & Shipping of Plant Mix Bituminous Pavements .. 4-49
4.5.14 Asphalt Concrete Surge and Storage Silos 4-49
4.5.15 Shipping Asphalt Mixtures 4-49
4.5.16 Surface Preparation for Asphalt Overlays 4-50
4.5.17 Adjustment of Manhole and Utility Covers 4-50
4.5.18 Asphalt Paving Equipment 4-50
4.5.19 Rollers 4-52
4.5.20 Weather and Date Limitations 4-52
4.5.21 Spreading and Finishing 4-52
4.5.22 Rolling and Compacting 4-54
4.5.23 Open-graded Wearing Course 4-56
4.5.23.1 Wearing Course 4-56
4.5.23.2 Suitability of Aggregate 4-57
4.5.23.3 Mix Design 4-58
4.5.23.4 Mixing 4-58
4.5.23.5 Surface Placement 4-58
4.5.24 Acceptance Testing Requirements and Tolerances 4-59
4.5.24.1 Subbase 4-59
4.5.24.2 Roadbase and Recycled Aggregate Materials (RAM). 4-60
4.5.24.3 Dense-graded Asphalt Pavements. 4-61
4.5.24.4 Compaction of Dense-graded Asphalt Pavement 4-62
4.5.24.5 Open-graded Asphalt Wearing Course. 4-63
4.5.24.6 Asphalt Pavement Surfaces 4-63
4.6 Bituminous Seal Coat (Chip Seal). 4-64
4.6.1 Material Specifications 4-64
4.6.1.1 Bituminous Material 4-64
4.6.1.2 Aggregate (Chips) 4-64
4.6.2 Aggregate Quality Control 4-65

4.6.3 Equipment 4-66
4.6.3.1 Asphalt Distributor 4-66
4.6.3.2 Aggregate Spreader 4-67
4.6.3.3 Rollers 4-67
4.6.3.4 Dump Trucks 4-67
4.6.3.5 Loaders 4-67
4.6.3.6 Power Brooms 4-68
4.6.4 Bituminous Chip Seal Construction Methods 4-68
4.6.4.1 Surface Preparation 4-68
4.6.4.2 Asphalt Application 4-68
4.6.4.3 Aggregate Spreading 4-69
4.6.4.4 Aggregate Compaction 4-69
4.6.4.5. Loose Aggregate Removal 4-70
4.6.4.6. Sanding 4-70
4.6.4.7. Appearance 4-70
4.6.4.8. Weather Limitations 4-71
4.7 Asphalt Emulsion Seal Coat (Slurry Seal) 4-71
4.7.1 Material Specifications 4-71
4.7.1.1. Asphalt Emulsion 4-71
4.7.1.2. Aggregate 4-71
4.7.1.3. Filler 4-71
4.7.1.4. Set Control Additive 4-71
4.7.1.5. Water 4-75
4.7.2 Material Quality Control 4-75
4.7.2.1. Sampling and Testing 4-75
4.7.2.2. Job Mix Design 4-75
4.7.3 Equipment 4-76
. 4.7.3.1. Slurry Mixing Machine 4-76
4.7.3.2. Slurry Spreader 4-76
4.7.3.3. Surface Cleaning Equipment 4-77
4.7.3.4. Auxiliary Equipment 4-77
4.7.4 Asphalt Emulsion Slurry Construction Methods 4-77
4.7.4.1. Resident Notification 4-77
4.7.4.2. Vehicle Removal 4-77
4.7.4.3. Preparation of Surface 4-77
4.7.4.4. Cleaning Streets 4-77
4.7.4.5. Sewer Manhole Lids and Water Valve Covers 4-78
4.7.4.6. Test Section 4-78
4.7.4.7. Water Fog 4-78
4.7.4.8. Preparation of Slurry 4-78
4.7.4.9. Application of Slurry 4-79
4.7.4.10. Handwork 4-79
4.7.4.11. Joints 4-79
4.7.4.12. Curing 4-79
4.7.4.13. Weather Limitations 4-79

4.7.5 Fog Coat 4-80
4.7.5.1. Equipment 4-80
4.7.5.2. Material 4-80
4.7.5.3. Application 4-80
4.7.5.4. Weather Limitations 4-80
4.7.5.5. Cure Time 4-81
4.7.5.6. Preparation of Pavement Surfaces 4-81
4.7.5.7. Sanding 4-81
4.8 Concrete Work 4-81
4.8.1. Materials 4-81
4.8.1.1 Portland Cement Concrete Material 4-81
4.8.1.2 Concrete Reinforcing Materials. 4-88
4.8.1.3 Curb, Gutter, Sidewalk and Base Materials 4-89
4.8.2. Construction Methods and Equipment 4-90
4.8.2.1 General Concrete Placement 4-90
4.8.2.2 Concrete Reinforcement Installation 4-92
4.8.2.3 Curb, Gutter and Sidewalk Concrete Placement. 4-93
4.8.2.4 Concrete Base Materials Placement. 4-97
4.8.3. Quality Control 4-97
4.8.3.1 Concrete Testing 4-97
4.8.3.2 Concrete Base Material Testing 4-98
4.8.3.3 Acceptance 4-98
4.9 Restoration of Existing Surface Improvements. 4-99
4.9.1 Introduction 4-99
4.9.2 Gravel Surfaces 4-99
4.9.3 Bituminous Surfaces 4-100
4.9.4 Concrete Surfaces 4-100

SECTION 5 SIGNING AND PAVEMENT MARKINGS

5.1 Introduction 5-1
5.2 Signing Materials, Fabrication and Placement 5-1
5.2.1 Street Name Signs 5-1
5.2.2. Traffic Signs 5-1
5.2.3 Visibility 5-1
5.3 Pavement Markings 5-1
5.3.1 Line Types 5-2
5.3.2 Pavement Word and Symbol Markings 5-2
5.3.3 Traffic Paint 5-2
5.3.4 Temporary Markings 5-3
5.3.5 Raised Pavement Markers 5-3

LIST OF TABLES

Table 3.1 Street Cross-section Configurations 3-3
Table 3.2 Facility Type- Access Distance From Corner 3-6
Table 3.3 Design Speed 3-8
Table 3.4 Sight Distance at Intersections 3-9
Table 3.5 Safe Stopping Sight Distance 3-10
Table 3.6 Horizontal Curves 3-10
Table 3.7 Driveway Type and Adjacent Street Classification 3-12
Table 3.8 Street and Gutter Capacity for the 10-year Storm 3-20
Table 3.9 Sanitary Sewer Design Flows 3-26
Table 3.10 Sanitary Sewer Minimum Slopes 3-27
Table 3.11 Sanitary Sewer Laterals 3-29

Table 4.1 Sewer Pipe Dimensions 4-6
Table 4.2 General Pipe Requirements 4-11
Table 4.3 Corporation Stops 4-15
Table 4.5 Backfill Material 4-21
Table 4.6 Air Testing 4-32
Table 4.7 Exfiltration Test 4-33
Table 4.8 Minimum Roadway Structural Requirements 4-39
Table 4.9 Subbase Aggregate Gradation 4-40
Table 4.10 Roadbase Aggregate Gradation 4-42
Table 4.11 Marshall Design Requirements 4-45
Table 4.12 Paving Grade Liquid Asphalt Requirements 4-46
Table 4.13 Dense-graded Asphalt Aggregate Gradation 4-49
Table 4.14 Climate Limitations 4-52
Table 4.15 Open-graded Asphalt Aggregate Gradation 4-56
Table 4.16 Rubberized Liquid Asphalt Requirements 4-57
Table 4.17 Subbase Sieve Size and Deviation 4-60
Table 4.18 Roadbase and (RAM) Sieve Size and Deviation 4-61
Table 4.19 Bituminous Material 4-64
Table 4.20 Gradation of Aggregate for Chip Seal Coats 4-65
Table 4.21 Slurry Seal Test Specifications - Tests of Emulsions 4-72
Table 4.22 Slurry Seal Test Specifications - Tests of Residue 4-73
Table 4.23 Slurry Seal Test Specifications - Tests on Slurry Seal Job Mixture 4-74
Table 4.24 Slurry Mixture Gradation 4-75
Table 4.25 Fine Aggregate 4-82
Table 4.26 Fine Aggregate Gradation Requirements 4-82
Table 4.27 Course Aggregate 4-83
Table 4.28 Course Aggregate Gradation Requirements 4-84
Table 4.29 Concrete Mix Specifications 4-87
Table 4.30 Synthetic Reinforcing Fibers 4-88
Table 4.31 Reinforcing Bar Clearance 4-93

SECTION 1

INTRODUCTION

1.1 INTRODUCTION. This section contains the general conditions and instructions for development and other related construction of infrastructure improvements within Washington County. It sets forth the conditions by which this work with take place. It also sets forth the duties, responsibilities and obligations for the construction of improvements. These conditions apply to all development related work.

1.2 DEFINITIONS. Wherever used in these specifications the following terms have the meanings indicated, which are applicable to both the singular and plural thereof.

1. **AASHTO:** The American Association of State Highway and Transportation Officials.

2. **ACCESS:** An intersection or driveway that connects with a public roadway to provide ingress and egress to a property or parcel of ground, whether public or private.

3. **ANSI:** The American National Standard Institute.

4. **APPROVED DOCUMENTS:** The approved drawings, standard specifications, standard drawings, and any other approved supplemental specifications and conditions.

5. **APPROVED DRAWINGS**: The graphic and pictorial portions of the approved documents approved by the County's Representative showing the design, location and dimensions of the work, and generally include: the plan, profiles, elevations, cross sections, details, schedules and diagrams, etc.

6. **ASTM:** The American Society for Testing Materials**.**

7. **AWWA:** The American Water Works Association.

8. **APWA:** The American Public Works Association

9. **BACKFILL:** Any earth that has been excavated from a trench or other excavation and then replaced and compacted with existing or imported material.

10. **BENCH MARK:** A surveyor's mark made on a stationary object of previously determined position and elevation and used as a reference point for surveys or other applicable points.

11. **BONDS:** An instrument of security submitted by the owner and approved by the County to guarantee and/or warranty the required improvements.

12. **COUNTY:** Washington County, Utah, a governmental entity having authority to adopt and enforce ordinances.

13. **COUNTY ENGINEER**: The officially appointed Professional Engineer designated as the "County Engineer" to act in behalf of and for Washington County. May also refer to the County Engineer's designated representative.

14. **COUNTY'S REPRESENTATIVE (PUBLIC WORKS DIRECTOR)**: The person designated to act for and in behalf of Washington County, or their designee.

15. **COUNTY SURVEYOR**: The officially designated Professional Surveyor who acts in the capacity as the County Surveyor, or their designee.

16. **CONTRACTOR:** The person, firm, or corporation with whom the owner has entered into an agreement to construct the necessary work.

17. **CUSTOMER**: One for whom County related services are rendered.

18. **DECELERATION LANE**: An auxiliary lane, independent from through traffic lanes, which is developed to allow turning vehicles to reduce their speed when approaching a driveway or intersection.

19. **DEFECTIVE WORK:** The work that is unsatisfactory, faulty or deficient, does not conform to the approved documents, does not meet the requirements of any inspection, reference standard, test or approval referred to in the approved documents, or has been damaged prior to the County Representative's final inspection.

20. **DEVELOPER:** The authority, corporation, association or firm which undertakes the development or subdivision of land or properties and with whom the Contractor has entered into an agreement and for whom the work is to be provided.

21. **DEVELOPMENT:** The process of constructing a building or group of buildings for residential, commercial, industrial or other uses or the general changing of land or property into something other than its current or natural state or condition.

22. **DRAWING OF RECORD:** The drawing(s) or plan(s) which show the locations and dimensions of constructed facilities, based on actual measurements taken in the field, as governed by County policy and ordinances.

23. **EMBANKMENT:** Any raised area of compacted earth used to support a roadway, curb and gutter, sidewalk, trail, structure, parking lot, etc. Material used for an embankment will be specified and tests will be performed to determine the material's adequacy for the specific project.

24. **ENGINEER:** A Civil Engineer registered with the Utah State Department of Business Regulation and licensed to practice as a Professional Engineer in the State of Utah.

25. **FILL:** Any material used to fill a depression, hole, or any other anomaly in the ground. Material used for the fill will be specified and tests will be performed to determine the material's adequacy for the specific project. An embankment is a type of fill.

26. **FINAL ACCEPTANCE**: Satisfaction on the part of the County's Representative that all work is fully complete and there are no other obligations to be fulfilled by the Contractor or the Developer.

27. **FINAL INSPECTION**: An inspection of the work which is conducted by the County's Representative(s) and other necessary parties, after having said the work is fully completed.

28. **FIRE CHIEF:** The officially appointed person designated as the County Fire Chief for Washington County or their designated representative.

29. **FLOOD PLAIN:** That area of a channel, river or other water course and the adjacent land areas which are inundated during abnormally high water (flooding) generally associated with a 100-year or 500-year flood event.

30. **FLOOD WAY:** The area of the flood plain that is or must be reserved in order to pass the 100-year flood event in accordance with applicable regulations and which will not be encroached upon by construction, fill or other development.

31. **GEOTECHNICAL ENGINEER:** That Professional Engineer registered with the Utah State Department of Business Regulation and licensed to practice as a Professional Engineer in the State of Utah specializing in Geotechnical investigations which has been retained to investigate soil and other similar conditions and submit recommendations and/or reports concerning said conditions.

32. **HILLSIDE DEVELOPMENT STANDARDS:** Any standards that may be noted in the Washington County Hillside Ordinance.

33. **INSPECTION PUNCH LIST:** A written list of work discrepancies and deficiencies compiled by the County's Representatives and others during a final or other inspection.

34. **I.T.E.:** The Institute of Transportation Engineers.

35. **WASHINGTON COUNTY STAFF MEETING:** A group of representatives from utility companies and Washington County Staff in the Washington County area that meet as needed to review utility and development plans as required.

36. **LAWS AND /OR REGULATIONS:** Any federal, state, county, city, or local jurisdiction's laws, rules, regulations, ordinances, codes, and orders.

37. **MAXIMUM DRY DENSITY:** The Maximum Dry Density as determined by ASTM Standard D-1557.

38. **MUTCD:** "The Manual of Uniform Traffic Control Devices", latest edition and revisions as published by the U.S. Department of Transportation, Federal Highway Administration.

39. **OWNER:** The authority, corporation, association or firm with whom the Contractor has entered into an agreement and for whom the work is to be provided. This can refer to the Developer or the Owner of the property being developed.

40. **OWNER'S ENGINEER (OR THE ENGINEER):** The professional engineer or engineering firm (registered with the Utah State Department of Business Regulation) which has been retained by the Owner to produce plans, specifications, oversee work, etc. required by the Owner in the prosecution of the development of said Owner's properties. (See Engineer).

41. **OWNER'S REPRESENTATIVE:** The person, firm, or corporation designated to act for and in behalf of the owner.

42. **PLANS (DRAWINGS):** The graphic and pictorial portions of the documents approved by the County's Representative showing the design, location and dimensions of the work, which generally include all details, schedules and diagrams required for construction of the project.

43. **POWER DEPARTMENT:** Refers to any of the Power Departments that provides service to residents of Washington County.

44. **PRIVATE IMPROVEMENTS:** The work or improvements which are undertaken by the Owner or Developer for the benefit of a select group of private individuals, which are not maintained or repaired by the County, and are not dedicated to the County for public use.

45. **PROJECT:** The total work to be provided under the approved documents.

46. **PUBLIC IMPROVEMENTS:** The work or improvements which are dedicated to and maintained by the County for the benefit of the public-at-large

47. **SHOP DRAWINGS:** All drawings, diagrams, illustrations, schedules, and other data prepared by or for the Contractor to illustrate some portion of the work as well as all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by suppliers and submitted by the Contractor to illustrate material or equipment required for some portion of the work.

46. **SOILS REPORT (GEOTECHNICAL REPORT):** The report produced by the Owner's Geotechnical Engineer and submitted to the County. It shall describe the existing conditions for the foundation soil of the land being considered for development by the Owner. The said report also sets forth that the said Engineer's recommendations concerning the requirements of the said soils for the intended use. (A soils report is the same as a Geotechnical report).

47. **SPECIFICATIONS:** Those portions of the approved documents consisting of these Standard Specifications as well as other requirements for materials, equipment, construction systems, standards, and workmanship, as applied to the work and certain applicable administrative details.

48. **STANDARD SPECIFICATIONS:** The specifications contained in these documents.

49. **STREET NAME SIGNS:** Public and private signs indicating the street name, address coordinate, type of road, color designation, or combination thereof.

50. **STRUCTURAL ENGINEER**: The Professional Engineer or engineering firm specializing in structural engineering and design; which has been retained to design and engineer the structural elements required in the project under consideration.

51. **SUBCONTRACTOR:** An individual, supplier, firm, or corporation having a contract with the Contractor or with any other subcontractor for the performance of any part of the work.

52. **SUBGRADE (SUBBASE):** Subgrade shall refer to the native, prepared original soil or engineered fill under any roadway, fill, embankment, structure, etc.

53. **SUPPLEMENTARY CONDITIONS:** The part of the approved documents which amends or supplements the Standard Specifications.

54. **SUPPLIER:** A manufacturer, fabricator, distributor, material producer, or vendor.

55. **SURVEYOR:** An individual registered with the Utah State Department of Business Regulation and licensed to practice as a Professional Land Surveyor in the State of Utah.

56. **T.I.S.:** The Traffic Impact Study which may be required by the County and furnished by a Traffic Engineer for and in behalf of the Owner/Developer in accordance with all applicable standards and requirements of the County.

57. **TRAFFIC SIGNS:** All regulatory, warning, advisory, informational, and other roadside traffic signs placed.

58. **UNDERGROUND FACILITIES:** All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments. As well as any encasement containing facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communication, cable television, sewage and drainage removal, traffic or other control systems, or water.

59. **WATER DEPARTMENT:** Refers to any of the water companies that provide service to the residents of Washington County.

60. **WORK:** The construction services and materials required to be furnished in accordance with the approved documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction.

61. **WORK COMPLETION or COMPLETION OF WORK:** Work and all obligations which have been fulfilled in accordance with the approved documents.

62. XERISCAPE: Desert-type landscaping requiring low-water demand as approved by the County.

1.3 BONDS AND INSURANCE. The Contractor shall be required to obtain all necessary bonds and to carry and provide proof of all necessary insurances needed to carry out the work.

1.4 STARTING AND COMPLETING THE WORK. The Contractor shall start the work in a timely manner after receiving the approved plans. Work shall be performed in an expeditious manner so as not to unduly inconvenience the public. Work should be continuous without long periods of stoppage.

1.5 BEFORE CONSTRUCTION BEGINS. Before undertaking each part of the work, the Contractor shall carefully study and compare the approved plans and check and verify pertinent figures shown thereon and all applicable field measurements. The Contractor shall promptly report to the Owner and the County's Representative any conflict, error or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from the Owner's Engineer and the County's Representative before proceeding with any work affected thereby.

Before any work at the site is started, Contractor shall deliver to County's Representative copies of all permits which Contractor is required to purchase/obtain and maintain, and Contractor's written plan to control quality of products and workmanship in the work.

1.6 PRECONSTRUCTION CONFERENCE. Before Contractor starts the work at the site, Contractor will attend a conference with Owner, Owners Engineer, County's Representative and others for the following purposes.

1. To discuss the work and the proposed schedule,
2. To discuss procedures for processing the project,
3. To designate the name of the individual who shall have the authority to act for the Contractor at all times while work is in progress, and
4. To establish a working understanding among the parties as to the work.

1.7 APPROVED DOCUMENTS INTENT. It is the intent of the approved plans and the standard specifications to describe a functionally complete project to be constructed in accordance with County Standards and good engineering practices. Any work, materials, or equipment that may reasonably be inferred from as being required to produce the intended result will be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials or equipment, such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or laws or regulations in effect at the time of approval of the project, except as may be otherwise specifically stated.

If, during the performance of the work, Contractor finds a conflict, error or discrepancy in the approved plans or these standards, Contractor shall so report to the Owner and the County's Representative at once and before proceeding with the work affected thereby shall obtain an interpretation or clarification from Owner's Engineer and County's Representative.

1. In the event of any discrepancy between the scaled dimensions on any drawing and the written dimensions shown thereon, the written dimensions shall be taken as correct.

2. Any part of the work which is not mentioned in the specifications, but is

shown on the drawings, shall be furnished and installed by Contractor as if fully described in the specifications.

3. Work and materials shall conform to the lines, grades, dimensions and material requirements, including tolerances, shown in the Standard Specifications and on the Approved Drawings. Although measurements, sampling and testing may be considered evidence as to such conformity, County's Representative shall be the sole judge of whether the work or materials deviate from the approved documents and County representative's decision as to any allowable deviations therefrom shall be final. Deviation from approved documents, as may be required by the needs of construction, will be determined in all cases by the County representative.

   Performance by the Contractor shall be required only to the extent consistent with the approved documents and reasonably interpreted from the approved plans and standard specifications and any approved supplementary specifications as being necessary to produce the intended results. In case of an irreconcilable conflict between provisions the County representative's decision shall be final.

1.8 AMENDING AND SUPPLEMENTING THE APPROVED DRAWINGS. The approved drawings may be amended on or after the effective date to provide for additions, deletions and revisions in the work thereof. All amendments, supplements, changes, and directives require approval of the County representative or his authorized representative.

1.9 UNDERGROUND FACILITIES SHOWN OR INDICATED. The information and data shown or indicated in the approved plans with respect to existing underground facilities, at or contiguous to the site, are generally based on information and data furnished by others, unless it is otherwise agreed to:

1. The County shall not be responsible for the accuracy or completeness of any such information or data;

2. Contractor and Owner shall have full responsibility for reviewing and checking all such information and data, with the one-call center (Blue Stakes location center) or other utility coordination service, prior to any excavation, to locate all underground facilities shown or indicated in the approved plans, for coordination of the work with the owners of such underground facilities during construction, and for the safety and protection thereof and repairing any damage thereto resulting from the work.

1.10 UNDERGROUND FACILITIES NOT SHOWN OR INDICATED. If an underground facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the plans the Contractor shall promptly, and before performing any work affected thereby (except in an emergency), identify the owner of such underground

facility and give appropriate notice thereof to that owner and to County's Representative. The Owner's Engineer will promptly review the underground facility to determine the extent to which the plans should be modified to reflect and document the consequences of the existence of the underground facility. The plans will be amended or supplemented to the extent necessary. During such time, Contractor shall be responsible for the safety and protection of such underground facility.

1.11 REFERENCE POINTS AND MONUMENTS. Owner's Representative shall establish land survey reference points for construction to enable Contractor to proceed with the work. The Contractor shall be responsible for laying out the work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior approval of County's Surveyor. The Contractor shall report to the County's and Owner's Representative whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

The Contractor shall not disturb any survey monuments found within the construction area until approved by the County's Surveyor. No survey monument shall be disturbed or moved until County's Surveyor has been notified and Owner's Representative has referenced the survey monument for resetting.

1.12 CONTRACTOR'S RESPONSIBILITIES - SUPERVISION AND SUPERINTENDENTS. The Contractor shall supervise and direct the work competently and efficiently, devoting such attention thereto and applying such skills and expertise as necessary to perform and complete the work in accordance with the approved plans and the standard specifications. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor shall be responsible for seeing that the finished work complies accurately with the approved documents.

The Contractor shall keep on the site at all times during the work's progress a competent superintendent. The superintendent will be Contractor's representative at the site and shall have authority to act on behalf of Contractor**.** All communications given to the superintendent shall be as binding as if given to Contractor.

1.13 SAFETY AND PROTECTION. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the work and other persons and organizations who may be affected thereby;
2. All the work and materials and equipment to be incorporated therein, whether in storage on or off the site; and
3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities

not designated for removal, relocation or replacement in the course of construction.

The Contractor shall comply with all applicable laws and regulation of any public body having jurisdiction for the safety of persons or property, or to protect them from damage, injury, or loss. The Contractor shall erect and maintain all necessary safeguards for such safety and protection. The Contractor shall notify owners of adjacent property and of underground facilities and utility owners when prosecution of the work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the Contractor, any subcontractor, supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the work or anyone for whose acts any of them may be liable, shall be remedied by Contractor. Contractors' duties and responsibilities for the safety and protection of the work shall continue until such time as all of the work is completed and County's Representative has issued a notice to Contractor that the work is acceptable.

The County, its officers, employees and agents, and the County's Representative shall not be answerable or accountable in any manner for any damage or loss that may happen to the work or any part thereof; for any material or equipment used in performing the work; for injury to property or person or persons; for damage to property; or for damage to adjoining property from any cause whatsoever during the progress of the work or at any time before final acceptance.

The Contractor shall have the charge and care of the work and shall bear the risk of injury or damage to any part thereof by any acts of God or the elements or from any other cause. The Contractor shall rebuild, repair and restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before the date of final acceptance and shall bear the expense thereof.

The County may make, or cause, to be made such temporary repairs as is necessary to restore service to any damaged facility. The cost of such repairs shall be borne by the Contractor.

The Contractor acknowledges that he is familiar with and will conform to the latest general safety orders of the State Industrial Commission, as contained in the Utah Occupational Safety and Health Act. The presence on site of an inspector or other person representing the County shall not in any way be construed to limit the Contractor's full responsibility for safety of all persons on the premises.

1.14 SITE EMERGENCIES. In emergencies affecting the safety or protection of persons or the work or property at the site or adjacent thereto, Contractor, without special instruction or authorization from County's Representative is obligated to act to prevent threatened damage, injury or loss. The Contractor shall give County's Representative prompt written notice if Contractor believes that any significant changes in the work or variations from the approved documents have been caused thereby.

1.15 AUTHORIZED VARIATIONS IN WORK. Variations in the work shall be authorized by the Owner's Engineer and approved by the County's Representative.

1.16 REJECTING DEFECTIVE WORK. County's Representative and the Owner and his Engineer will have authority to disapprove or reject work which they believe to be defective, and will also have authority to require special inspection or testing of the work whether or not the work is fabricated, installed or completed.

1.17 WARRANTY AND GUARANTEE. Contractor warrants and guarantees to County that all work will be in accordance with the approved documents and will not be defective. All defective work, whether or not in place, may be rejected, corrected or accepted with conditions at the sole discretion of the County. If within the one year guarantee period, or such longer period of time as may be prescribed by laws or regulations, or by the terms of any applicable special guarantee required, or by any specific provision of the approved documents, any work is found to be, defective regardless of cause, the Owner shall promptly cause the Contractor, without cost to the County, to either correct such defective work, or, if it has been rejected by the County, remove it from the site and replace it with non-defective work.

1.18 INSPECTIONS AND OBSERVATIONS. The Contractor shall give County's Representative at least twenty-four (24) hours notice of readiness of the work for all required inspections, or approvals. Inspections and tests made at any point other than the point of incorporation in the work shall not be considered as a guarantee of acceptance. Any retesting of work or materials rejected shall be at Contractor's expense..

County's Representative(s), Owner's Engineer, testing agencies and governmental agencies with jurisdictional interests will have access to the work at reasonable times for their observation, inspecting and testing. The Contractor shall provide proper and safe conditions for such access.

If laws or regulations of any public body having jurisdiction require any work (or part thereof) to specifically be inspected, tested or approved by other than County's Representative and the Owner's Engineer, Contractor shall assume full responsibility therefor, and furnish the County's Representative the required certificates of inspection, testing, or approval.

The Contractor shall be responsible for all costs in connection with any inspection or required testing in connection with County's acceptance of materials supplied, or equipment proposed to be incorporated in the work, or of materials or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the work.

All work and materials, and the manufacture and preparation of such materials from the beginning of the work until work completion, shall be subject to acceptance or rejection by the County's Representative.

Any work or materials not in accordance with the approved documents that may be discovered before work completion shall be corrected upon notification by County's Representative. Inspection by County's Representative shall not relieve Contractor from responsibility to furnish material and workmanship in accordance with the approved documents. Failure on the part of County's Representative to discover, condemn or reject materials or work shall not be construed to imply acceptance of the same should their noncompliance become evident before work completion. It is expressly understood that nothing in this paragraph waives any of the County's rights under the guarantee provision of these specifications.

1.19 CONTRACTOR EMPLOYEES. Only competent employees of the Contractor, or subcontractor, shall be employed on the work project. Any person employed by Contractor, the sub-Contractor themselves, or subcontractor employees, who is found by County's Representative to be incompetent, intemperate, troublesome, disorderly or otherwise objectionable, or who fails or refuses to perform work properly and acceptably, shall be immediately removed from the work project by the Contractor and not be re-employed on the work project.

1.20 HISTORIC, ARCHAEOLOGICAL OR PALEONTOLOGICAL DISCOVERIES. If a suspected regulatory historic, archeological or Paleontological item, feature, or site is encountered, construction operations shall be immediately stopped in the vicinity of the discovery and the Owner and proper state and/or federal agencies shall be notified of the nature and exact location of the findings. The Contractor shall not damage the discovered objects.

The Owner shall keep the County's Representative informed as to the status of any restrictions placed upon the project and when such restrictions are removed.

1.21 WORKING HOURS. Construction activities on the contract work site shall comply with any applicable local noise and other ordinances. Unless otherwise directed or upon approval of different hours by County's Representative, working times at the work site shall be limited between dawn and dusk. Work shall not proceed on Saturday, Sunday, or on any legal holidays without prior approval from the County's Representative.

1.22 UNCOVERING WORK. If any work is covered or buried contrary to the request of County's Representative, it must, if requested, be uncovered for observation, inspection or testing as may be required to verify compliance at the Contractor's expense.

1.23 COUNTY'S REPRESENTATIVE MAY STOP THE WORK. If the work is defective, or the Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the work in such a way that the work will not conform to the approved documents, County's Representative may order Contractor to stop the work, or any portion thereof, until the cause for such an order has been eliminated.

1.24 CORRECTION OR REMOVAL OF DEFECTIVE WORK BY CONTRACTOR. If required by the County's Representative, the Contractor shall promptly, as directed, correct all defective work, whether or not fabricated, installed or completed, or if the work has been rejected by the County's Representative, remove it from the site and replace it with non-defective work. The Contractor shall bear all direct, indirect and consequential costs of such correction or removal (including but not limited to fees and charges of the County, engineers, architects, attorneys and other professionals) made necessary thereby.

1.25 ONE YEAR CORRECTION PERIOD. If within the one year guarantee period, or such longer period of time as may be prescribed by laws or regulations, or by the terms of any applicable special guarantee required, or by any specific provision of the approved documents, any work is found to be, defective regardless of cause, the Owner shall promptly cause the Contractor, without cost to the County, either correct such defective work, or, if it has been rejected by the County, remove it from the site and replace it with non-defective work. If the Contractor fails within thirty days to promptly comply with the terms of such instructions, or in an emergency where notice and delay would cause serious risk of loss or damage, the County may have the defective work corrected or the rejected work removed and replaced, and the Owner shall be liable for all direct, indirect and consequential costs of such removal and replacement.

The one year correction period shall similarly apply to all rework done by the Contractor.

1.26 ACCEPTANCE OF DEFECTIVE WORK. If, instead of requiring correction or removal and replacement of defective work, and the County prefers to accept it, the County may do so. Owner shall bear all direct, indirect and consequential costs attributable to County's Representative evaluation of and determination to accept such defective work.

1.27 CORRECTION OR REMOVAL OF DEFECTIVE WORK BY OWNER. If Owner fails within a reasonable time after written notice of County's Representative to correct defective work or to remove and replace rejected work, as required by County's Representative, or if Contractor fails to perform the work in accordance with the approved documents, County may, after seven days' written notice to Owner, correct and remedy any such deficiency. All direct, indirect and consequential costs of County in exercising such rights and remedies will be charged to the Owner. Such direct, indirect and consequential costs will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, all court costs and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of defective work.

1.28 WORK FULLY COMPLETED. When Owner considers the work (or portion thereof) ready for its intended use, Contractor shall certify in writing to County's Representative that the work (or portion thereof) has been completed in accordance with the approved documents. If fully completed, County's Representative shall within

fifteen (15) days, schedule a final inspection preparatory to writing the final inspection punch list and in accordance with these standard specifications and County policies.

1.29 FINAL INSPECTION. After all construction work is complete, the Developer shall request a Construction Completion Inspection (final inspection). Upon receipt of the request the County shall schedule this inspection with the appropriate parties. Any faulty or defective work shall be detailed in the County's inspection report. All faulty and defective work shall be corrected within 30 days from the date of the County's inspection report. If, after thirty days, the faulty or defective work has not been completed, another final inspection may be conducted by the County to determine if additional corrective work is required. The development will not be released and the guarantee period will not commence until all faulty work has been corrected.

1.30 FINAL WALKTHROUGH. Prior to the end of the guarantee period, a final walk through will be conducted. The Owner and the Contractor should contact the County's Representative to schedule the walk through. All work found to be defective shall be corrected immediately. This is preparatory to final acceptance by the County.

1.31 FINAL ACCEPTANCE. If, on the basis of Owner's and Contractor's request that work is given final acceptance and County's Representative is satisfied that the work has been satisfactorily completed the County's Representative will give written notice to Owner that the work is acceptable and the guarantee period will start. Otherwise, County's Representative will indicate in writing to Owner the reasons for refusing to recommend final acceptance, in which case Owner shall make the necessary corrections and resubmit request for final acceptance approval.

1.32 SUSPENSION OF WORK. The County's Representative shall have the authority to suspend the work wholly or in part for such period as County's Representative may deem necessary due to unsuitable weather or to other conditions the County's Representative considers unfavorable for suitable prosecution of the work. The Contractor shall immediately comply with the County's Representative order to suspend the work wholly or in part. The suspended work shall be resumed when the conditions are favorable and methods are corrected as approved by the County's Representative.

In the event the suspension of work is ordered for any reason, the Contractor, at Contractor's expense shall do the work necessary to provide a safe and secure site. If pedestrian or vehicular access is required, a smooth and unobstructed passageway shall be provided through the construction site for use by the public. In the event the Contractor fails to perform this work, the County may perform such work and the cost thereof will be billed to the Contractor or Owner.

SECTION 2

GENERAL REQUIREMENTS

2.1 INTRODUCTION. This section defines the general requirements for public improvements. This section defines the general requirements for development work and other related construction of infrastructure improvements within Washington County. It covers such items as drawing requirements, inspections, traffic control, cooperation with others, use of explosives and other miscellaneous requirements.

The improvements shall include all public and private infrastructure, including, but not limited to streets, water, sewer, traffic and drainage. Required improvements shall extend from the nearest acceptable point of existing improvements. Layouts must provide for future extension to adjacent properties and shall be compatible with appropriate Washington County master plans or general plans. All underground improvements shall be installed to the boundary lines of the development and in some cases extended beyond the boundary to assure system reliability. Required Geotechnical investigation recommendations shall be followed.

2.2 CONSTRUCTION DRAWINGS. Complete and detailed construction plans, drawings of improvements, and all necessary reports shall be submitted to the County for review and acceptance. All plans, drawings and reports submitted shall be stamped and signed by a professional Civil Engineer licensed in the State of Utah.

The instructions contained herein are for the purpose of standardizing the preparation of drawings and to obtain uniformity in appearance, clarity, size and style. The plans and drawings shall meet the standards hereinafter outlined.

All drawings and/or prints shall be clear and legible and conform to standard engineering and professional drafting practice.

The standard drawing size shall be twenty-four by thirty-six inches.

Note: Construction work shall not begin until the appropriate construction plans and reports have been reviewed for compliance with County requirements and released for construction by the County representative.

2.2.1 GENERAL. The following shall be included on the drawings. The County may require additional information as it deems necessary:

A. North arrow.

B. Scale - Standard engineering scales shall be used. Uncommon scales generated by CAD systems shall not be used. Graphic scales should be used where drawings may be reduced.

C. Stationing and elevations for profiles - Profiles should be drawn directly below plan view when possible. Bench marks and elevations must be referenced to latest revision of USGS datum or other datum as may be approved.

D. Title block, located on the right side of the sheet to include:

1. Project title;

2. Type of project;

3. Professional Engineers stamp (licensed in the State of Utah) and signature.

4. Name, address and phone number of firm preparing drawings.

5. Date, drawing number, drawn by, checked by, and other appropriate information.

6. Name, address and telephone number of Owner/Developer and contact person.

E. Revision block located in or above title block containing the revision number, description, date, and reviser's name.

F. Drawings shall have a heavy border outlining the entire sheet situated approximately 1/2 inch from the top and sides and 1 inch from the bottom.

G. Additional information as required by the Washington County Staff Meeting (WCSM) shall also be required on the drawings. (See the WCSM for requirements).

2.2.2 CURB AND GUTTER, DRAINAGE, SIDEWALKS AND STREETS. The drawings for curb and gutter, drainage, sidewalks, and streets shall contain:

A. Plan view showing all necessary information to completely detail the work to be constructed including, but not limited to, all existing improvements, right-of-way lines, easement boundaries, roadway centerline, curb and gutter location, sidewalks, cross drains, cut and fill slopes, drainage pipes, etc. for each street.

B. Top back of curb and street centerline elevations at one hundred (100) foot intervals or at every lot line and at all P.C.s, midpoints and P.T.'s. At all street intersections, elevations shall be shown at the half delta points (minimum).

C. Standard engineering stationing and all curve data.

D. Plan, profile, and details of drainage system showing flow directions, pipe grades, inlets, clean outs, invert elevations, and types of pipe, etc.

E. Bench mark locations and elevations (latest revisions of USGS datum must be used).

F. Typical street cross section from right-of-way line to right-of-way line, showing type of curb, sidewalk and pavement section.

G. Gradient center line of roads, top, back of curbs (if different from the centerline), or edge of the pavement (if different from centerline and no curb exists), and flow-lines of drainage pipes and channels. Profiles shall be shown at all intersections to assure that street grades transition smoothly. Transition grades shall not be left to be worked out in the field!

H. Location of existing and proposed permanent survey monuments.

I. Profiles shall show existing ground profile at the centerline and each right of way line.

J. When matching into existing improvements, profiles shall be extended for a minimum of two hundred and fifty (250) feet to assure that road transitions are smooth. When matching into existing improvements on the opposite side of the street, cross-sections shall be shown indicating how the new portion will match.

2.2.3 SEWER/STORM SEWER. Sewer drawings shall show:

A. Plan and profile sheets showing location, size, and grade of main lines, sub-mains, and service laterals (existing and proposed).

B. Manhole or catch basin size, type, station (location) and elevation at top of manhole or grate and flow-line (in and out).

C. Type of pipe (in accordance with County's standards).

D. Bench mark locations and elevations (latest revision of U.S.G.S. datum shall be used).

E. Trench details showing bedding backfill, compaction and shoring requirements.

2.2.4 CULINARY WATER. Culinary water drawings shall show:

A. Size, location and type of all existing and proposed water mains, valves and hydrants, service laterals and all necessary appurtenances.

B. Type of pipe (in accordance with County standards).

C. Profile drawings showing high and low elevation with respect to grade.

D. Minimum cover shown. (in accordance with County Standards based on elevation.

E. Typical and special trench details showing bedding, backfill, compaction and shoring requirements.

F. Backflow protections devices.

2.2.5 SECONDARY WATER. Any secondary water drawings shall show:

A. Size, location and type of all existing and proposed water mains, valves, service laterals and all necessary appurtenances.

B. Type of pipe (in accordance with County standards).

C. Profile drawings showing high and low elevation with respect to grade.

D. Minimum cover shown. (in accordance with County Standards based on elevation.

F. Typical and special trench details showing bedding, backfill, compaction and shoring requirements.

G. One inch service with a 1" meter setter with customer side shut-off will be installed to each lot.

H. All piping including service laterals must be purple in color and clearly marked irrigation.

I. The meter shut-off must be installed within a purple meter box clearly marked "irrigation".

J. All piping to be installed must have a ten-foot minimum separation from culinary piping.

K. All main line valve boxes must be triangular in shape.

2.2.6 POWER. Power drawings shall show:

A. Point of interconnect (to be determined by County's Representative before plans are prepared and submitted).

B. Location of existing and proposed transformers, service boxes, street lights, etc.

C. Primary, secondary and service lines and phasing details.

D. Topography, driveway locations if determined, and proposed grading unless shown on grading plans.

E. Sizes, capacities and characteristics of all components (e.g., wire, transformers, etc.).

F. Approval block for respective utility.

2.2.7 DETAIL SHEETS. Each set of plans shall be accompanied by a separate sheet of details (unless already shown on standard drawings) for structures which will be constructed. Detail sheets shall include the following information:

A. Drawing size: twenty-four by thirty-six inches.

B. Scale of each detail.

C. Title block on the right side of the sheet (same format on all sheets).

D. Information required in section 2.2.1.D, E. and F.

E. All details must be properly dimensioned and labeled.

F. All details shall conform to the details shown in the standard drawing section of these standards. All details not in conformance with the standard details shall require individual approval.

2.2.8 GRADING/EROSION CONTROL PLAN. All development projects and projects requiring installation of improvements are required to obtain a grading permit. A grading plan shall be submitted showing, at a minimum, the details outlined in the Building Code**.** The grading plan should be included with the Construction Drawings when submitted to the County Representative for review. Erosion control must be included in the plan. A Soils Engineering Report and an Engineering Geology Report addressing the adequacy for the intended use of the proposed development shall be submitted with the grading plan. When Construction Drawings, including the grading plan, are approved by the County's

Representative, a grading permit will be issued upon payment of the required grading plan review and permit fees in accordance with the fee schedule included in the Building Code.

2.2.9 GENERAL UTILITY LOCATION INFORMATION.

The following information is provided as a general guide in laying out utilities during the preparation of construction drawings. This information is to be used as a guide and may be changed by the County as required.

A. A proximity detail and street locations will be required for all utility drawings

B. The sewer, drainage and power layouts should be the first utilities designed.

C. For joint trench details, placement and layout of utilities and burial depths see standard drawings.

D. A joint trench for phone, cable and power shall be located on the north and west side of the roadway in the utility easement (whenever possible) or opposite gas.

E. Water and gas lines shall be located on the south and east side of the roadway with the gas line in the utility easement and water line located ten feet from the centerline of the roadway (whenever possible) or opposite power.

F. Sewer lines will generally be located five feet from the centerline of the roadway on the same side of the road as the power system.

G. Storm drain lines should be placed under the curb and gutter as per standard drawing detail.

H. The cable and phone boxes will be located on the right and left side of power transformers and secondary boxes. The cable shall be on the left and phone on the right when looking from the street at the lot to be served.

I. Gas mains shall be located five feet from the right-of-way line within the utility easement.

J. Gas and water services will be placed five and three feet, respectively, to the right or left of the property line, with gas on the left and water on the right, looking from the street at the lot to be served. See standard drawings for details.

G. Color coding for utility conduits/lines shall be as follows:

Power	-	Black with red stripe or gray
Water	-	Blue or white or ductile iron
Sewer	-	Green or white
Gas	-	Orange or yellow
Phone	-	White or gray and labeled
Secondary Water	-	Purple
Cable TV	-	Terracotta (Red-orange)

2.2.10 DRAWING SUBMITTALS. Three (3) sets of construction plans and drawings shall be submitted to the County Representative for review. Additional sets of drawings in accordance with WCSM requirements shall also be submitted to the WCSM for review. When all revisions required by the County have been made and the plans accepted, five (5) complete sets shall be submitted to the County Representative for processing. Two sets of plans that have been appropriately stamped as released for construction will be returned to the applicant. One stamped set shall be kept available at the construction site at all times during the construction of the project.

2.3 INSPECTION, TESTING AND QUALITY CONTROL. All construction work involving the installation of improvements in Washington County shall be subject to Owner inspection and testing as outlined in the quality control section of each specification.

2.3.1 REQUESTS FOR INSPECTION. A request for inspection shall be made to the County by the person responsible for the construction. Notice shall be given at least twenty-four hours (or as otherwise directed) in advance of the starting of work. Any work requiring backfill or cover shall not be backfilled or covered prior to inspection. It should be noted that any inspection or observation by the County is for the County's sole use and does not relieve the Contractor or Developer from complying with County standards. The County provides "spot" inspections throughout the course of work. These inspections should not be confused with that of providing full time observation or inspection. It is recommended that the Developer retain the use of a professional engineering firm during the course of construction to provide the necessary full time inspections to ensure that said standards are met and to certify as such. Said certification is required for private developments.

2.3.2 CONSTRUCTION COMPLETION INSPECTION (FINAL INSPECTION). After all construction work is complete, the Developer shall request a Construction Completion Inspection. Upon receipt of the request the County shall schedule this inspection with the appropriate parties. Any faulty or defective work shall be detailed in the County's inspection report. All faulty and defective work shall be corrected within 30 days from the date of the County's inspection report. If, after thirty days, the faulty or defective work has not been completed, another inspection may be conducted by the County to determine if additional

corrective work is required. The development will not be released and the guarantee period will not commence until all faulty work has been corrected.

2.3.3. GUARANTEE OF WORK. All work shall be warranted and guaranteed to remain in good condition for a period of one year after the date indicated in Section 2.3.2 or other date as determined by the County representative. The responsible party shall agree to make all repairs to and maintain the improvements and every part thereof in good condition during the specified time at no cost to the County. A 20% improvement guarantee provided by the Developer of improvements will be required by the County for the period of the guarantee.

The determination for the necessity of repairs and maintenance of the work shall rest with the County representative. His decision upon the matter shall be final and binding. The guarantee hereby stipulated shall extend to and include, but shall not be limited to the entire road base, power system, telephone system, natural gas system, all pipes, joints, valves, appurtances, backfill and compaction as well as the working surface, curbs, gutters, sidewalks, and other accessories that shall be constructed. Whenever, in the judgment of the County representative, said work shall be in need of repairs, maintenance, or rebuilding, he shall cause a written or other notice to be served the responsible party and thereupon the responsible party shall undertake and complete such repairs, maintenance or rebuilding. If the responsible party fails to do so within thirty days from the date of the service of such notice, the County representative may have such repairs made, and the cost of such repairs shall be paid by the responsible party together with 25 percent of the cost of the repairs in addition thereto, for stipulated damages for such failure on the part of the responsible party to make the repairs. Any omission on the part of the County representative, or his designated representative, to condemn defective work or material at the time of construction shall not be deemed an acceptance. The Contractor will be required to correct defective work or material at any time within the guarantee period before final acceptance.

Prior to the end of the guarantee period, a final walk through for final acceptance will be conducted. All work found to be defective shall be repaired immediately. Upon completion of these final repairs, the work will be accepted by the County and all appropriate bonds released.

2.3.4 QUALITY CONTROL TESTING. Material testing shall be conducted by an independent testing laboratory. The testing laboratory used for this purpose shall be one that is approved by the County. All testing shall comply with current ASTM, AASHTO, AWWA, Public Drinking Water Regulation standards, or other applicable standards and these specifications. All testing shall meet the minimum testing requirements as outlined in the specifications. The cost of any and all re-testing required to bring materials into compliance shall not be borne by the County. If determined necessary by the County, additional testing may be

required. All testing shall be performed by the appropriately certified tester.

2.3.5 TEST REPORTS. Written test results will be required for review by the County after each portion of the work (i.e. pipeline construction, earthwork, curb, gutter and sidewalk, roadway construction) has been tested.

A final report of compliance will be required upon completion of the project. This report will include all test results, and any other items required in the plans and specifications.

A letter of compliance with minimum inspection and testing requirements as set forth herein must be submitted for any private subdivision, planned unit development and/or other developments which contain private streets. This letter must be of a form approved by the County and stamped and signed by a Professional Engineer licensed in the State of Utah.

2.4 DRAWINGS OF RECORD. Upon completion of the project and prior to final inspection, a complete set of Drawings of Record that includes all items specified in SECTION 2.2 Construction Drawings shall be submitted to the County. The Drawings of Record shall show all improvement dimensions as they were constructed in the field. The Drawings of Record shall be submitted on twenty-four inch by thirty-six inch sheets in accordance with County policy (unless otherwise directed by the County's Representative). Improvements and any bond held by the County shall not be released until drawings of record are received.

The Developer's project engineer shall be required to submit drawings of record containing the signatures of the contractor and the developer's engineer. The Developers Project Engineer shall be responsible for the accuracy of the record drawings and shall be stamped and signed by the Professional Engineer, that each drawing of record is complete and accurate.

The submitter shall also provide all drawings of record in AutoCAD format, on a CD or DVD with a .dwg file format; as well as in electronic pdf format or as otherwise directed by the County's Representative upon completion of the project.

2.5 BARRICADES AND WARNING SIGNS - WORK AREA PROTECTION. The Contractor shall provide, erect, and maintain all necessary barricades, channelizing devices, lights, warning signs, and other traffic control devices. All necessary precautions shall be taken to protect the work area and to safeguard the public and construction workers. Streets closed to traffic shall be protected by proper barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning and detour signs shall be provided to control and direct traffic properly. All traffic control operations and signing shall be performed in accordance with the instructions outlined in the "Manual on Uniform Traffic Control Devices (MUTCD)", latest edition. A traffic control plan shall be required on each project and approved by the County Engineer or County's Representative.

2.5.1 GENERAL TRAFFIC CONTROL REQUIREMENTS

The Contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and the protection of persons, property, general public, and residents along the street, highway, and areas adjacent to the work area shall be provided for by the Contractor.

Temporary traffic control devices shall be used to guide and channel traffic through construction areas. Devices shall include cones, portable barricades, vertical panels and other approved devices. Metal vertical panels shall not be used as channelization devices. Traffic cones shall not be permitted as traffic channelizing devices during the hours of darkness.

Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher type high level warning devices.

All temporary traffic control devices used during hours of darkness shall be properly reflectorized and lighted, in accordance with requirements of the MUTCD. Devices shall have adequate maintenance to retain the reflection and lighting capability. At all times, traffic control devices shall be erect, properly positioned, clean, and in full view of the intended traffic movement.

All traffic control devices shall be immediately removed from roadway or sidewalk when no longer needed.

A traffic lane should be a minimum of twelve feet (12') wide. Additional width may be necessary depending on the conditions encountered.

A minimum of two traffic lanes, one for each direction, shall be maintained open to traffic at all times on all major streets unless otherwise approved by the County representative.

When two-way traffic cannot be maintained, flag persons shall be provided. Flag persons must be certified and suitably equipped and properly clothed.

Unless otherwise approved by the County's Representative, all existing traffic lanes on major streets shall be maintained open to traffic.

Local access shall be maintained to all properties on the project at all times. When local access cannot be maintained, the Contractor must notify the affected property owner at least twenty-four hours in advance. Access shall be restored the same day of completion of work which caused loss of access.

A temporary traffic lane shall not be open to traffic unless it is paved with hot mix or cold mix asphalt or is graded reasonably smooth and maintained dust free as

directed by the County's Representative.

Arrangements for partial or complete street closure permits shall be obtained through the County representative or his designated representative. An advance notice of forty-eight hours for major streets and twenty-four hours for local streets and alleys is required. The Contractor shall be required to notify all emergency services (ambulance, fire, etc.) and all other necessary parties as dictated by the County's Representative.

The Contractor is responsible for all barricading, 24-hours a day, 7-days a week. In the event of inclement weather conditions, such as windstorms, rainstorms, etc. the Contractor (or his authorized representative) shall immediately inspect his work area and take all necessary actions to insure that public access and safety are maintained. In general trenches and excavations shall not be left open or uncovered over night. Special conditions may be given consideration by the County's representative.

The Contractor shall maintain all existing STOP, YIELD, street name signs and other traffic control devices until such time as construction requires their removal. At that time the Contractor shall obtain authorization from the County to remove said signs and posts without damage and deliver them to a storage site as directed by the County Representative. When required, the Contractor may need to install temporary signs (i.e., regulatory signs) until such time as permanent signs can be reinstalled.

If at any time project construction shall require the closure or disruption of traffic in any roadway or alley such that normal refuse collection will be interfered with, the Contractor shall, prior to causing such closure or disruption, make arrangements with the appropriate refuse removal service in order that collection service can be maintained.

The Contractor shall provide the County's Representative with a 24-hour emergency phone number of his representative(s) responsible for maintenance of barricades, warning signs and other traffic control devices.

2.6 COOPERATION WITH UTILITIES. The Contractor will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

The Contractor shall comply with the requirements of the Blue Stake one call system, in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water users' association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation

water and shall become acquainted with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cable ways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted by or under the direction of the facility owners at no expense to the County.

2.7 COOPERATION BETWEEN CONTRACTORS. The County reserves the right at any time to contract for and perform other or additional work on or near the work being done.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed by the County's Representative.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Public Agency from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. The Contractor shall join their work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others.

2.8 CONSTRUCTION STAKES, LINES AND GRADES. The Project Engineer will set construction stakes establishing lines and grades for road work, curbs, gutters, sidewalks, structures and centerlines for utilities and necessary appurtenances as may be deemed necessary. The Project Engineer (or the Developer) will furnish the Contractor all necessary information relating to the lines and grades. Such stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary controls and perform the work. A copy of the field notes shall be submitted to the County's Representative upon request.

The Contractor shall perform the work in accordance with construction stakes and marks, and shall be charged with full responsibility for conformity and agreement of the work with such construction markings. When obvious errors or conflicts occur in the staking, the Contractor shall stop work and immediately notify the Project Engineer or the County's Representative.

The Contractor shall be held responsible for the preservation of all stakes and marks, If the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost for replacing them will be borne by the Contractor.

2.9 USE OF EXPLOSIVES. The use of explosives or blasting is generally not allowed within the County, however, if explosives or blasting are permitted, their use is controlled by the County's adopted Fire Code. The Contractor shall obtain a special permit from the County for the use of explosives. The Contractor is responsible for proper use and handling of the explosives or for any and all damages resulting from their use.

Explosives shall be transported, stored, handled and used in accordance with the provisions and requirements of all applicable laws, ordinances and regulations.

2.9.1 GENERAL BLASTING CRITERIA

A. Blasting activity that is to occur within one thousand (1,000) feet of any school (public or private), university, day care center, church, library, medical facility, or any public building shall be conducted during off hours where possible.

B. Furnish and erect special signs to warn the public of blasting operations. Said signs shall be located and maintained so as to be clearly evident to the public during all critical periods of blasting operations.

C. Notify each public utility company, having structures or facilities adjacent to the work, of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to advise the Contractor of any precautions that should be taken to protect their structures from damage.

D. Blasting shall be accomplished in such a manner that nearby buildings, structures, railways, highways, etc. will be safe from rocks and other projectiles. Adequate blasting mats or other means of protection shall be employed when blasting in congested area or close proximity to any of the above improvements.

E. Immediately prior to the time of firing, the Contractor shall station certified flaggers along the road(s) at sufficient distance from the blasting operation to control traffic as required.

F. The County reserves the right to order the discontinuance of blasting operations at any time.

2.10 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE. The Contractor shall be responsible for the preservation of all public and private property and shall protect from disturbance or damage all survey control land monuments and boundary marks. Prior to disturbing any monuments, the Contractor shall notify the County Surveyor who shall require said Contractor to hire a licensed Surveyor to properly reference the monument, unless otherwise directed.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, defective work or materials, or

misconduct in his manner or method of executing the work, or in consequence of the non-execution thereof by the Contractor, he shall restore, at his expense and at no cost to the County, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner. Said responsibility shall not be released until the project has been completed and accepted.

The Contractor shall not dump spoil or waste material on private property without first obtaining written permission from the property owner. All such dumping shall be in strict conformance with any applicable Grading and Drainage Ordinances.

Prior to any construction in front of driveways the Contractor shall notify the property owner twenty-four hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability within twenty-four hours, or as otherwise approved by County's Representative. If it is necessary to leave open excavation for a longer period of time the Contractor shall provide structurally adequate steel plates to bridge the excavation.

2.11 SURVEY MONUMENTS. Class I or Class II survey control monuments (as shown in the standard drawings of these specifications) shall be installed on all dedicated and private streets. All survey control monuments shall be installed in strategic locations (as determined by the County's Representative) so as to insure adequate survey control required for subsequent resurvey in the area.

All Class I monuments shall be cross tied and referenced to permanent features and mapped sufficiently for future use in relocation and replacement. All cross tie information shall be submitted to the County Surveyor and should also be kept in a permanent record by the Professional Surveyor doing the work.

Any section, witness or reference corners which fall within roadway or parking lot construction areas shall be reset with a Class I type monument with appropriate cap (as shown in the standard drawings). All corners being replaced shall be referenced in a manner as to accurately reset the corner. A copy of the field notes shall be submitted to the appropriate public agency surveyors for approval before corners are destroyed. The appropriate public agency surveyors (city or county) shall give direction on requirements for referencing of corner(s) to be replaced and the method of reinstallation prior to corner(s) being destroyed.

2.12 HAZARDOUS MATERIALS DISCOVERIES. If suspected hazardous materials (including chemicals, petroleum products, etc.) are encountered, construction operations shall be immediately stopped in the vicinity of the discovery and the proper authority shall be notified of the nature and exact location of the findings. The Contractor shall secure the site of the discovery and shall provide written confirmation of the discovery and proper notification to the County's Representative within twenty-four hours. The written confirmation shall include a statement regarding responsibility to report the discovery to the local health district and the Utah Department of

Environmental Response and Remediation within twenty-four hours as required by Federal Statute as adopted by the State of Utah. The Contractor or the Property Owner shall then report the discovery as specified in the law.

After operations in the vicinity of the discovery have been restricted, the Property Owner shall keep the County informed concerning the status of the restriction. The time necessary for the Property Owner and appropriate Regulatory Agency to arrange for an acceptable solution to the discovered hazardous material situation is variable and dependent upon the nature and extent of the discovered materials. After clearance is received from the appropriate Regulatory Agency, the Property Owner shall inform the Contractor and the County Representative when work may be continued in the vicinity of the discovery. Written confirmation shall be provided within two calendar days.

2.13 IMPROVEMENT SEQUENCE. Improvements shall generally be installed in the following sequence, unless otherwise directed or approved by the County's Representative.

A. Construction Traffic Control
B. Rough grading
C. Sanitary Sewer
D. Storm Drainage
E. Culinary Water
F. Electrical Service
G. Telephone
H. Cable T.V.
I. Natural Gas
J. Sub Grade
K. Sub Base
L. Road Base
M. Curb and Gutter
N. Asphalt and/or Sidewalks
O. Street Signs and Pavement Markings
P. Manholes frames & covers and Valve boxes and covers raised to Grade
Q. Survey Monuments
R. Clean-up

Please note that this is a general sequence and is not intended to cover all aspects or steps of the construction work.

SECTION 3

DESIGN STANDARDS

3.1 INTRODUCTION. This section defines design requirements for public improvements. It is not the intent of these standards to restrict professional judgment, but rather to serve as a guide and to establish consistency in design.

These standards are the minimum required and should be considered as such. The APWA Manual of Standard Specifications shall be used as a supplement to these guidelines. In cases of conflict, a determination shall be made by the County representative, which determinations shall be final. It is recommended that the Engineer in charge review each project on its own merit and impose a higher professional standard as necessary for each project. These requirements apply as required by the Subdivision Ordinance.

3.2 STREET DESIGN. All streets shall be designed to conform to the standards and technical design requirements contained within this sub-section. AASHTO, "A Policy on Geometric Design of Highways and Streets" and the Utah Department of Transportation (UDOT) Standards and Specifications shall be used as supplements to these guidelines. In cases of conflict, a determination shall be made by the County representative, which determinations shall be final.

All new developments shall use the typical street cross-sections with fifty feet (50') or more of right-of-way unless specifically approved by the County Commission.

Access to multi-family or commercial developments, shall use street cross-sections with sixty (60) feet or more of right-of-way, unless a narrower section is specifically approved by the County Commission.

3.2.1 STREET CROSS-SECTION STANDARDS. Requirements for the street cross-section configurations are shown in Table 3.1. These requirements are based on traffic capacity, design speed, projected traffic, system continuity and overall safety.

3.2.2 ROADWAY NETWORK DESIGN. New roadway networks shall be designed in accordance with the general planning concepts, guidelines, and objectives provided within this sub-section. The "Quality of Life" for residential occupants shall be a primary concern when designing a residential roadway network.

A. An emphasis on proper street hierarchy should be adhered to, namely, local streets should access residential collectors; residential collectors should access major collectors; major collectors should access minor arterial; etc.

B. An emphasis on access management should provide control of the location, design, and operation of all driveways, median openings, and street connections to a roadway.

C. Roadways should be designed in a curvilinear method in order to reduce, or eliminate, long straight stretches of residential roadways which encourage speeding and cut through traffic.

D. Substantial increases in average daily traffic, due to development of adjacent property on established streets not originally designed to accommodate such increases should be avoided.

E. Drainage methods should concentrate on meeting the drainage needs while not impeding the movement of traffic.

F. Roads should be designed to lie within existing topographic features without causing unnecessary cuts and fills.

G. A reduction in the use of cul-de-sacs should be emphasized in order to provide greater traffic circulation and less volume on collector roads. Circulation is of the utmost importance. Long blocks and excessive dead end streets should be avoided.

H. Stopping sight distance must be considered at all intersections and curves to ensure the safety of the public, in accordance with AASHTO standards.

I. Pedestrians and bicycle traffic should be considered in the planning and design of all developed streets.

Table 3.1
Street Cross-section Configurations

Classification	Minimum ADT or [D.U.s]	Curb Type	Maximum Grade (%)[4]	Right of Way (feet)[3]	Pavement Width [1,3] (feet)	Sidewalk Width (contiguous (feet)
Residential Standard	1 to 1,500 [1 to 150]	high back	10	50	35	4
Minor Collector	1500 to 3,000 [150 to 300]	high back	10	60	43	5
Major Collector [2]	3000 to 6,000 [300 to 600]	high back	8	66	49	5
Arterial	6,000 to 20,000	high back	8	80-100	63 (min)	5

1 Pavement width measured from lip of curb to lip of curb.

2 Configuration of major collector and higher classifications may be adjusted with proper justification and approval of County representative.

3 The minimum right-of-way and pavement width is shown. Each may be increased when required by a traffic impact study.

4 Maximum grade may be increased only by approval of the Planning Commission.

3.2.3 IMPROVEMENT REQUIREMENTS. All improvements including, but not limited to the following, shall be constructed in accordance with the standard specifications and drawings unless otherwise approved.

3.2.3.1 Curb, Gutter and Sidewalk. Required curb, gutter and sidewalk shall be constructed.

3.2.3.2 Driveways. Driveways shall be constructed only in approved locations. No driveways shall be constructed unless an approved site plan has been submitted.

3.2.3.3 Pavement. All streets, public or private, shall be surfaced to grade, with asphalt concrete pavement, to the required minimum width and thickness in accordance with these specifications.

3.2.3.4 Cross Gutters. No cross gutters shall be allowed across major collector or arterial streets. The County representative may prohibit construction of cross gutters on any street deemed necessary.

3.2.3.5 Handicap Ramps. When new construction occurs handicap ramps shall be constructed at all street intersections, unless otherwise approved, in accordance with current ADA and applicable County standards. In addition, when a project occurs where existing improvements are in place, handicap ramps shall be upgraded to meet current ADA and County standards.

3.2.3.6 Roadway Medians and Round-Abouts. Medians or round-abouts on public roadways may only be allowed when approved by the County Commission. Design and construction shall be in accordance with applicable standards.

3.2.3.7 Minimum Access. Proposed developments shall have only the required number of accesses to adequately address the needs of the development and only at approved locations. Too many access points or access on major routes hinder the safety and efficient travel of vehicles using these routes. In addition, too few accesses can stifle circulation and unnecessarily concentrate traffic at selected locations.

3.2.3.8 Drainage. Adequate drainage facilities shall be installed to properly conduct runoff from the roadway. Sub-drains and surface drainage facilities shall be designed in accordance with an approved drainage study. Cross gutters shall be used sparingly to maintain the public's driving comfort and in accordance with these specifications.

3.2.3.9 Traffic Control Devices. Appropriate traffic control devices and street signs, as required by the County representative, shall be installed in accordance with the MUTCD.

3.2.3.10 Pavement Marking. Appropriate pavement markings, as required by the County shall be installed in accordance with the MUTCD.

3.2.3.11 Other Improvements. The above required improvements are not all inclusive. Other improvements needed to complete the development in accordance with current engineering and planning standard practice may be required by the County representative.

3.2.4 TECHNICAL DESIGN REQUIREMENTS. The following requirements apply to public streets.

3.2.4.1 Street Grades

A. All street grades shall have a maximum grade as shown in Table 3.1 and a minimum grade of 0.75%.

B. A request to increase the maximum street grades shown in Table 3.1 may be considered upon submittal of a request and information justifying

such a request to the County Planning Commission. Request for approval should be based upon and in accordance with the latest edition of AASHTO's “A Policy on Geometric Design of Highways and Streets” guidelines. Any approvals for increased grades should be consistent with access requirements of fire apparatus as defined by the Fire Chief. The County Commission’s decision will be final.

3.2.4.2 Intersections

A. All street intersections should intersect at ninety degree angles.

B. In the event an acute angle intersection is proposed, the County representative may require mitigation by realigning to achieve a ninety degree intersection. If no other reasonable option for realignment exists, a skew may be allowed up to a maximum of 15 degrees from 90 degrees. Other design approaches to mitigate the skewed angle may be required by the County representative.

C. Proper combination of horizontal and vertical alignment should be obtained by engineering study and consideration of the general guidelines listed in AASHTO (Section Titled: Combination of Horizontal and Vertical Alignment, current edition).

D. Intersections should not be located on the interior of, or near, sharp curves. Intersections should be located a sufficient distance from all curves to provide proper sight distance for vehicles on the intersecting road or driveway and on the through road.

E. New intersections with more than four “legs” are generally not permitted. For arterial access, only four-leg intersections and “T“ intersections are permitted. When designing local road networks, ”T“ and ”L“ intersections are desired. The ”L“ intersection (knuckle) will only be permitted when the street length, in either direction from the angle point, is six hundred feet (600), or less. Four-leg intersections on local road networks are generally discouraged. Where determined that a four-leg intersection is necessary, approval from the County representative shall be obtained prior to final design of the local road network. Exceptions to these requirements may be granted by the County representative on a case by case basis. The developer's engineer must provide acceptable compelling Traffic Engineering analysis justification before deviations will be granted.

F. When designing local road networks, block lengths without an intervening connector street shall not exceed sixteen hundred feet (1600') in length unless previous approval has been obtained from the County representative. Cul-de-sacs are not considered an intervening connecting street.

G. New access locations created by development shall be unified whenever possible to create the fewest number of access points onto arterials or major collectors. Cross use or shared access agreements shall be required where necessary.

H. Access to corner lots should be from the lesser-classified road at the greatest distance possible from the intersection, and should not be less than the distances shown below. This distance is measured from the PI of the corner curve as measured along the back of the curb.

TABLE 3.2
FACILITY TYPE
ACCESS DISTANCE FROM CORNER
(IN FEET)

Facility Type	Access distance to edge of driveway
Residential Standard	50
Collector	150
Arterial *	200

*All access points shall be approved by the County representative. Distances shown may be increased as required by the County representative on a case-by-case basis. Exceptions can only be approved by the County representative upon submittals of proper traffic justification.

I. The intersection of two local roads should be designed to operate with minimal traffic control devices. For example, avoid designing an intersection to operate with a four-way stop or signal control.

J. Direct access will not be allowed for parking, loading or driveway areas that require backing maneuvers onto major collector or higher order streets. This requirement shall apply to commercial and industrial use regardless of the order or classification of street.

K. Residential and commercial developments are generally required to provide at least two improved accesses to the development depending upon the forecasted traffic volumes. Adjacent developments may be required to combine or share driveway access to public roadways. The access shall be of proper width to accommodate the calculated traffic volumes and expected vehicle types when the area is fully developed and shall be in accordance with the Zoning Ordinance. Projected traffic volumes shall be calculated using the criteria outlined within the Traffic Impact Study requirements of

these specifications.

L. Covered driveways will not be allowed unless approved by the County representative.

3.2.4.3 Intersection Spacing

A. Street intersections shall be spaced far enough apart so that the existing and projected traffic stopped to make left turns at one intersection does not interfere with traffic movements at the adjacent intersection and to not hinder the capacity or safety of the roadway. When a street intersects a low volume residential street, the minimum distance is 200 feet. When a street intersects a minor or major collector street, the minimum distance is 250 feet. Minimum distance measurements are centerline-to-centerline. The minimum spacing requirement on arterials shall be as determined by the County representative. Locations shall be based upon a number of items such as projected volumes, turning and stacking distances, intersection spacing, traffic progression, etc. Generally the minimum distance will be 650 feet for arterials. The County representative shall review and give final approval to any intersection requests on arterials.

3.2.4.4 Maximum Design Volume

A. The maximum design volume shown on Table 3.1 shall be used unless otherwise approved by the County representative. A request to increase these volumes may be submitted for consideration to the County representative. This request shall include all necessary and required information including support and justification from the Traffic Impact Study.

Conditions which must be considered when reviewing a request for an increase in maximum design volume include hillsides, safety, parking, traffic studies, access requirements, etc.

3.2.4.5 Cul-de-Sac Streets

A. Such streets shall not exceed six hundred (600') feet in length as measured from center of cross street to center of Cul-de-sac. The turn-around pavement radius shall not be less than forty-two and one-half feet (42 1/2') (50 feet at property line). Commercial pavement radii shall be no less than forty-seven and one-half feet (47 1/2') (55 feet at property line). No road shall be ended without a properly designed cul-de-sac turnaround unless otherwise approved by the County representative. Major collectors and higher order roads shall not be permanently dead-ended.

3.2.4.6 Sidewalks

A. Sidewalk shall be required in all residential and commercial developments. See Table 3.1.

B. For developments which are within hillside areas, sidewalk along one

side of the street may be waived upon approval of the County representative if adequately justified to reduce scarring or facilitate improved drainage.

C. Sidewalks in areas of high pedestrian traffic may require greater width as determined by the County representative.

D. Meandering sidewalks are discouraged and must be approved by the County representative.

3.2.4.7 Curb and Gutter

A. All public or private streets shall use curb and gutter of the type shown in standard drawings unless otherwise approved by the County representative.

3.2.4.8 Design Speed

A. The design of geometric features such as horizontal and vertical alignment will depend on the design speed selected for each street. The design speed is primarily determined by the street function and classification, and is the maximum speed for safe and comfortable operation of a vehicle. The use of design speeds other than those listed below must be approved by the County representative who may decide that the speed provided in this sub-section be changed to that which is reasonable and prudent under the conditions and having due regard to the actual and potential hazards.

TABLE 3.3
DESIGN SPEED*

Classification	Design
Residential Standard	25
Collector	35
Arterial	50

* Variance of design speeds on residential collectors or higher order roads may be granted by the County representative to no greater (or less) than five MPH increments when conditions warrant. Variances will not be granted for short segments of roads, but for entire contiguous stretches so that consistency and driver expectancy are maintained, which will be reviewed on a case-by-case basis with approved design criteria.

3.2.4.9 Clear Sight Distance at Intersections

A. At intersections adequate clear sight distance should be provided to permit drivers entering the higher order street from a driveway or STOP-controlled intersection to see approaching traffic from a long enough

distance to allow them to decide when to safely enter the higher order street and complete their turning maneuvers in advance of approaching traffic. Clear sight distance, for both left and right turning vehicles, should be in accordance with AASHTO guidelines and generally as follows:

TABLE 3.4
SIGHT DISTANCE AT INTERSECTIONS

Through Street Design Speed	Sight* Distance
25	280
30	335
35	390
40	445
45	500
50	555
55	610
60	665
65	720

*Sight distances should be adjusted with cross road grades, approach grades and for more than one lane of traffic each direction.

3.2.4.10 Vertical Alignment

A. Vertical curves shall be provided in all changes in grade where the algebraic difference is greater than one (1).

B. Longitudinal street grades shall not be less than 0.75 percent unless adequate alternative street drainage is provided, nor more than ten (10) percent, unless specifically approved by the County Planning Commission.

C. Vertical curve stopping sight distance design shall utilize criteria recommended by the latest edition of AASHTO. K-values shall be noted on all design drawings.

D. Minimum cross slope from street crown shall be two percent (2%) with three percent (3%) generally recommended and the maximum four percent (4%) unless otherwise approved by the County representative.

E. Vertical alignment with the intersection is also of special nature, and design alternatives may be required. As a guideline, the approach area where vehicles stop while waiting to enter an intersection should not exceed five (5) percent from the gutter line of the street being intersected for a distance of fifty (50) feet, though a range of fifty (50) to one hundred (100) feet is more desirable. This applies to all intersections, except those where

both intersecting streets are minor or major collectors. In this situation, the landing area for a residential and major collector which is controlled by a STOP or YIELD sign should be designed for a grade of three percent for a distance of one hundred feet. Any other major intersection streets shall be approved by the County representative.

3.2.4.11 Safe Stopping Sight Distance

A. The minimum sight distance (length of roadway visible to the driver) to be provided for through traffic traveling at, or near, the design speed to stop before reaching a object in its path should be in accordance with AASHTO guidelines and generally as follows:

TABLE 3.5
SAFE STOPPING SIGHT DISTANCE

Design Speed	Required Distance
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	650

3.2.4.12 Horizontal Curves

A. The recommended minimum centerline radius for horizontal curves should be in accordance with AASHTO guidelines and generally as follows:

TABLE 3.6
HORIZONTAL CURVES

Design Speed	Curve Radius in Feet
25 MPH	205
30 MPH	300
35 MPH	420
40 MPH	565
45 MPH	730
50 MPH	930
60 MPH	1190
65 MPH	1505

3.2.4.13 Superelevation

A. Maximum superelevation for roads shall be four (4) percent unless otherwise approved by the County representative.

B. The use of superelevation shall require prior approval from the County representative.

3.2.4.14 Deceleration Lanes

A. Deceleration lanes may be required on streets in conjunction with driveways and/or intersections adjacent to a proposed development. They are specifically required when all of the following factors are determined to apply:

B. 5,000 vehicles per day are using or are projected to use the street;

C. The 85th percentile traffic speed on the street is thirty-five (35) miles per hour or greater; or forty (40) miles per hour for a two lane (one lane each direction) roadway; and

D. Fifty (50) vehicles or more making right turns into the driveway or street during a one-hour peak period.

The lane lengths for a deceleration lane shall be determined on a case-by-case basis and must receive prior approval of the County representative. In addition to the above guidelines, deceleration lanes may be required in connection with the results of a Traffic Impact Study or by the County representative.

3.2.4.15 Driveway Profiles

The slope of a driveway can dramatically influence its operation. Usage by large vehicles can have a tremendous effect on operations if slopes are severe. The profile, or grade, of a driveway should be designed to provide a comfortable and safe transition for those using the facility, and to accommodate the storm water drainage system of the roadway.

Suggested treatments of driveway grades are illustrated below. While 8 percent should be the maximum allowable initial grade (G1), maximum grades of 1 to 3 percent are preferable for high-volume driveways and 3 to 6 percent for low-volume driveways.

TABLE 3.7

Driveway Type and Adjacent Street Classification	Maximum Range for G2 (Departure Grade)
Low Volume Driveway** on Local Street	-8% to 14%
Low Volume Driveway** on Collector Street	-4% to 8%
Low Volume Drive** on Arterial Street	-1% to 5%
High Volume Driveway*** on Any Street	-1% to 5%
* The preferable grade of G1 is 3% to 6% for low volume driveways and 1% to 3% for high volume driveways. ** Low Volume Driveway - defined as a driveway with less than 100 vehicles in the peak hour in the peak direction. *** High Volume Driveway - defined as a driveway with more than 100 vehicles in the peak hour in the peak direction.	
Maximum suggested change in Grade: Initial Grade Minus Departure Grade = 12% for any 10 feet of distance without a vertical curve.	

3.2.4.16 Alignment and Continuity - Off-Site

A. Normally, off-site pavement construction requires asphalt concrete paving to the right-of-way centerline and in some cases beyond. When asphalt pavement is existing, the developer's engineer shall submit to the County representative sufficient information prepared by the Engineer to indicate vertical and horizontal alignments are maintained and adequate drainage is provided for. The developer may be required to replace all, or any portion of existing roadway, in a manner that two-way traffic can be maintained without the use of potentially hazardous alignment transitions (vertical or horizontal) and in a manner to ensure that adequate drainage is provided for. As a minimum, there shall be twenty eight feet (28') of paving to accommodate through traffic. Required parking and shoulders are not included in the twenty eight feet (28').

When off-site pavement construction consists of improvement to the right-of-way centerline (approximately), leading and trailing transition tapers shall be placed at each end of the improvements. Horizontal transition tapers shall be designed and constructed off site based upon the roadway speed and in accordance with the taper requirements in the MUTCD and applicable AASHTO guidelines unless otherwise approved by the County representative.

B. When paving for partial street construction, the edges of the pavement

are to be protected by placing a minimum two feet of aggregate base material beyond the edge of pavement matching the pavement grade.

C. Wherever partial street construction is required, grades shall be set for the future curb line and approved by the County's Representative. The future grades shall be compatible with the curb and centerline grades for the partial street construction. It shall be required to design the roadway for a minimum of two hundred (200) feet to as much as one thousand (1000) feet beyond the development to ensure a future match.

D. Where a street abruptly ends or transitions, proper signage according to the MUTCD shall be required. Safe transitions into existing elevations shall be required where new roads transition into existing surfaces, i.e. gravel or natural surface.

3.2.5 PAVEMENT STRUCTURAL DESIGN

The structural details shown on the standard drawings are minimum requirements. The actual structural section for each roadway shall be designed by accepted Engineering design methods for flexible pavement (i.e. AASHTO**,** UDOT or CALTRANS). Required subgrade soil properties shall be obtained from an on-site geotechnical investigation. Required traffic information for design shall be approved by the County representative.

The geotechnical investigation shall be conducted by the Geotechnical Engineer. The investigation shall include a thorough exploration and sampling program of the subgrade to determine the nature and engineering properties of the on-site soils within the roadway construction area. For new construction and reconstruction projects, the minimum sampling and testing requirements are as follows.

A. Excavate test holes to a minimum depth of ten feet below finished grade and street. There shall be at least one test hole for every five hundred feet (500') of roadway or more often with obviously variable soils conditions, or as approved by County Representative.

B. Calculate "CBR" values using AASHTO T 193 three point using T 180 (Method D) for mold compaction with exceptions as listed in 5.1.1 through 5.1.3 of Test Method T193.

C. Minimum Testing Frequency for "CBR" values shall be as follows:

a. Two tests with at least one test per significant soil type for roadway lengths of one foot to one thousand feet.

b. Three tests with at least one test per significant soil type for roadway lengths of one thousand feet to five thousand feet.

c. Two tests per five thousand feet of roadway (or portion thereof) with at least one per significant soil type for any roadway over five thousand feet.

D. Conduct sieve analysis using either current AASHTO or ASTM standards. If needed, conduct a sand equivalent test to determine the presence or absence of plastic fine material using either AASHTO T176 4.3.2 alternate method No. 2, pre-wet 4.3.3 mechanical shaker or ASTM D24199.4.2 Procedure B, 11.6.1 mechanical shaker. One test for each stratum of each test hole.

E. Calculate density in place using the drive-cylinder method ASTM D2937or nuclear method ASTM D2922with a minimum of two tests per hole.

F. Calculate resistivity and pH using test methods AASHTO T-288 and AASHTO T-289 with at least one test per each metal pipe culvert location.

G. Expansion index of soils shall be determined using the ASTM D4829 test method. This test shall be conducted whenever potentially expansive soils are encountered in a test hole.

The above schedule represents minimum sampling and testing requirements. The Registered Professional Engineer responsible for directing and controlling the geotechnical investigation shall analyze each project to determine actual sample locations, frequency and testing program beyond the minimums given above.

The above testing and design requirements may be waived by the County's Representative providing a prior development has already performed the above testing, design and construction on the first half of the roadway in the same location. In this case the new development shall match the existing roadway section.

3.2.6 MAIL BOXES. Community (clustered) mailboxes are encouraged and the location must be shown on the construction drawings and approved by the Postal Service and the County representative. All roadside mail boxes should be installed in accordance with applicable postal standards in the following locations: In areas where the sidewalk is next to the curb, install boxes behind the sidewalk so as to not encroach into the sidewalk; in areas where a planter strip is provided, mail boxes may be installed within the strip, provided no part extends into the sidewalk or beyond the back of the curb; in rural areas where no

barrier curb is installed, a minimum clear zone of ten feet from the traveled way must be provided.

3.2.7 SIGNS AND PAVEMENT MARKINGS. All street name and traffic control signs and pavement markings required on the street system within a development or as a result of the development, shall be installed at the developer's expense in accordance with the standard drawings and MUTCD standards. A signing plan should be submitted with the engineering drawings; however, additional signing and traffic control may be added to the project as determined by the County's Representative.

3.2.8 UNDERGROUND WATER. When underground water in or adjacent to the site is encountered by geotechnical investigation or during the construction work, the County's Representative and the Project Engineer shall be notified immediately. The Project Engineer shall cause the necessary studies to be made and the required mitigation work to be installed.

3.3 SOIL STUDY GUIDELINES. The construction of all improvements is subject to the recommendations of a soils investigation report. This information shall be submitted at the same time improvement plans are submitted to the County representative. The findings contained in the soils report shall be used as the basis for the design and construction of the project improvements unless otherwise directed by the County's Representative.

The soils investigation shall be conducted by a Geotechnical Engineer. The report shall be sufficiently comprehensive to determine the location and nature of all soils within the project construction area.

3.3.1 GEOTECHNICAL REPORT. The Geotechnical Report shall be prepared by a Utah Professional Engineer. A Geotechnical Report shall be required for all commercial and industrial projects, and all residential lots and subdivisions. In addition to the requirements set forth in the applicable Building Code, the report shall include, but need not be limited to, the following information:

A. A site plan(s) showing the general site vicinity, the project boundary clearly identified, the location of any existing or proposed structures within the site, and the location of exploration test pits and/or borings.

B. A general description of the topography, drainage conditions, vegetation, surface features such as rock outcrops, existing structures, debris, and unstable or wet surface conditions.

C. A description of the proposed structure(s) and improvements to be constructed on the site, as well as anticipated structural loads.

D. Continuous logs of all test pits/borings. Soil classification shall be by the

Unified Soil Classification System. Elevations, when possible, shall be shown on the tops of explorations on the same elevation datum as the project improvement plans. Elevation and depth of groundwater, if encountered, shall be shown. A description of the exploration and sampling methodology shall be provided.

The minimum exploration requirements are as follows:

D.1 For single lot projects, a minimum of 1 (one) test pit/boring shall be provided. Additional test pits/borings shall be provided for larger projects at the discretion of the County Building Official.

D.2 For subdivisions, a minimum of 1 (one) test pit/boring on each proposed lot, and 1 (one) test pit/boring per 500 lineal feet of street proposed for construction.

D.3 For proposed planned unit developments, a minimum of 1 (one) test pit/boring per one half (1/2) acre of total area within the planned development not designated as open space areas, and 1 (one) test pit/boring per 500 lineal feet of street proposed for construction.

D.4 For street improvement projects, a minimum of 1 (one) test pit/boring per 500 lineal feet of street proposed for construction shall be provided.

D.5 Exploration depths shall be a minimum of 15 feet below the proposed lowest floor elevation, including basements, in building areas and 10 feet below the finish street grade elevation in public street areas.

D.6 In areas where highly expansive soil is encountered or is suspected to exist, soils investigations shall be based upon a minimum of 3 test pits/borings, with at least 1 test pit/boring on each lot. A highly expansive soil consists of a soil/rock that expands/swells a minimum of 8 percent (under a 60 psf surcharge) with the addition of water. Each exploration shall extend 3' minimum into the expansive soil layer, or 20' minimum total depth, whichever is less.

E. An evaluation of the site for the presence of potential geologic hazards such as expansive soils, compressible/collapsible soils, gypsiferous (soluble) soils, uncontrolled fills, shallow groundwater, and stability of slopes. The extent of any geological hazards identified on the site shall be mapped.

F. An evaluation of possible impacts of the proposed development on adjoining properties, and any mitigating measures that should be undertaken. Some impacts to be considered are: (a) extensive cuts and fills and associated slope stability; (b) surface drainage; and (c) the addition of subsurface water

in sensitive soil areas.

G. Laboratory test results. Laboratory testing shall be conducted, according to American Society for Testing Materials, (ASTM) Standards, to evaluate the nature and engineering properties of the subgrade soils.

H. Conclusions and recommendations which shall contain, but not be limited to, the following information:

H.1 Site preparation and grading requirements, including the suitability of on-site soils for use as fill material, fill placement procedures, and compaction requirements, etc.

H.2 Geotechnical design considerations for drainage structures and/or erosion control, if applicable.

H.3 Procedures for mitigation of any potential geological hazard, such as special foundation systems groundwater control, and any special grading recommendations such as over excavation and re-compaction, etc.

H.4 For design recommendations involving expansive soils, the soils engineer shall use a wet depth model based upon actual expected wetting conditions with a minimum depth of 3 feet. Any swell potential found is to be listed in total inches, and is to be defined with respect to an expected loaded condition of the structure to be constructed (i.e, not necessarily tested to the actual loads, but listed as an expected swell movement for expected load condition.)

H.5 Suitable foundation types, with allowable bearing pressures and estimated settlements.

H.6 Slope stability calculations shall be included as part of the report where cut/fill or natural slopes exceed 20 feet in height. Calculations shall use a recognized analysis method and show minimum factors of safety consistent with professional practice.

H.7 Design recommendations for street improvement areas, which shall include preliminary pavement design recommendations, sub-grade preparation, suitability of the on-site soils for use as pipe bedding, pipe zone, and general backfill materials, and trench excavation and stability.

I. A separate and final pavement design investigation shall be conducted prior to construction, after street locations and grades are established and the improvement plans prepared. The structural details shown on the standard

drawings are minimum requirements. The actual structural section for each roadway shall be obtained from field sampling and laboratory testing. Required traffic information for design shall be approved by the County Engineer.

J. The Geotechnical Report shall list required inspections, observations, and tests necessary during construction.

3.4 DRAINAGE AND FLOOD CONTROL DESIGN. This sub-section sets forth the criteria for engineering design of drainage and flood control systems.

3.4.1 GENERAL REQUIREMENTS. All development in the County that requires a grading permit or exceeds one acre in area, and all commercial development, shall submit a Drainage Control Plan and Report.

All drainage plans shall conform to the requirements set forth in this section and be approved by the Washington County representative or his designee.

Drainage and flood control plans shall be designed to conform to any applicable Flood Control Master Plans.

Drainage facilities shall be designed using currently accepted civil engineering standards of practice, applicable safety standards, and County or other approved design specifications.

In general, each development should handle its storm water runoff in such a manner that no increase in the 2, 10, or 100-year peak storm runoff above the pre-development and/or natural state will occur on downstream properties.

In general, development changes the characteristics of drainage from sheet flow to point discharge flow. While the flow rate of water may be controlled, the effects of all point discharges must be handled to insure no detrimental effects downstream of development.

Drainage facilities should be analysed, designed, and constructed to protect the development from the 100-year peak storm runoff. Most drainage collection system capacities for new development shall be sized for a minimum of the 10-year flood event, but no significant damage or risk of personal injury may occur from the 100-year flood event. Major hydraulic structures (including bridges, large culverts, and open channels) will be designed for the 100-year flood event.

For analysis purposes of the drainage system of a drainage basin area, all of the drainage basin upstream of the proposed development should be analysed for the conditions of new and/or planned development in conformance with the County's current Land Use Master Plan. Effects on downstream property owners and the downstream flood control system shall be considered in the design and

any negative impacts mitigated or design changes presented to mitigate problems to the satisfaction of the Washington County representative or his designee. This may include acquisition of easements or agreements and/or construction or modification of existing improvements where needed both within the development and/or downstream. All storm drainage and flood control systems shall be separate and independent from the sanitary sewer system.

Development of any kind should not cause a natural drainage channel to be filled in, obstructed, or diverted. When modifications to a natural drainage channel are proposed within the development, such changes will be addressed in the Drainage Control Plan and Report and shown on the improvement plans, and must be approved by the Washington County representative and any applicable permits obtained (i.e. Utah State Stream Alteration or Federal 404 permits) prior to proceeding. In the event that modifications to natural drainage channels are approved, necessary easements and rights-of-way for structures and improvements shall be provided to the County.

The point where the natural drainage channel(s) of a drainage basin enters and leaves a property owner's property will not be changed without approval of the County representative and any applicable permits obtained.

Improvements designed to protect a development shall be considered permanent and shall be designed and constructed accordingly. Such improvements shall be maintained by the property owner or the agreed upon maintaining agency.

Development shall provide the necessary means to insure drainage within the property being developed makes use of existing facilities and/or natural washes and shall be required to construct any appropriate Flood Control Master Plan improvements that meet County design standards and proper flood control requirements.

3.4.2 DESIGN CRITERIA - STREETS. Streets are a significant and important component in urban drainage and may be made use of in storm water runoff within reasonable limits. The primary purpose of streets is for traffic. Reasonable limits for the use of streets as conveyance for storm water runoff shall be set by the Washington County representative. Design criteria for gutter capacity and associated lane encroachment will depend on the roadway type as shown in the table below (Table 3.8). Street designs should include surface drainage relief points (inlets). This is especially important for flat gradient areas, local sumps or depressions and cul-de-sacs. For pedestrian safety, street flows must be limited such that the product of the depth (ft.) and velocity (ft./sec.) does not exceed six (6) for the 10 year flood event and eight (8) for the 100-year flood event. Curb overtopping is not permitted for the 10 year flood event. When street encroachment limits are exceeded as indicated in table 3.8, an underground storm sewer system shall be required. Where this underground conveyance is required to limit street flows, it will be designed to handle at least the 10-year

flood event.

TABLE 3.8

Street and Gutter Capacity for the 10 year Event	
Street Classification	Maximum encroachment
Local (residential)	No curb overtopping. Flow may spread to crown of street.
Collector	No curb overtopping. Flow must leave at least one lane of travel free.
Arterial	No Curb overtopping. All travel lanes to remain open.

Streets must also provide for routing of the 100-year flood event to adequate downstream conveyance facilities. The 100-year flood event should be contained within the street right-of-way and any adjacent drainage easements.

3.4.3 DESIGN CRITERIA - STORM DRAINS. Storm drain design conveyance capacity will be sized for a minimum of the 10-year, three hour flood event. The 100-year, three hour flood event will be used for evaluation and prevention of significant damage which may result from street overflow. Inlets must have sufficient capacity to prevent local ponding from the 10-year flood event, with fifty (50) percent blockage of inlets by debris. Analysis of combined street and storm drain capacity for the 100-year flood event will be used to determine maximum ponding depths and water levels and demonstrate that these depths are non-damaging. In instances where sufficient combined capacity does not exist the storm drain size may have to be increased beyond that of the 10 year flood event.

In areas where underground water may infiltrate into the storm sewer system the pipe size should be increased accordingly. In general, ground water will not be allowed to flow to the surface and collected in streets, gutters or in any other surface flow situation that allows flow into street gutters or street right-of-way.

Design of curb inlets can allow for differences in interception capacity of inlets on a positive gradient as compared to interception capacity of inlets in sag locations. Inlet spacing and location of inlets will be designed for continuous positive grades or sag situations as appropriate. Inlets will be spaced so as to keep the street encroachment within the limits set in Table 3.8 for the 10-year flood event and those indicated in this document for the 100-year flood event. Sag points may be required to have additional inlets spaced to control the maximum level of ponding that will be allowed to occur around the sag/inlet area.

All storm drains will be designed by application of the Manning equation. Minimum design velocity shall be 2.0 ft/sec. for the storm drain pipe when flowing one-half full. The Manning's "n" value shall represent that value that will be

expected during the main portion of the useful life of the pipe which may differ from that of a new pipe. The hydraulic grade line and/or water surface elevation profile will be shown for all pipe systems. The minimum storm drain diameter shall be 15-inches unless otherwise approved.

Storm drains shall not be designed for surcharged (pressure) pipe conditions unless otherwise approved by the Washington County representative.

3.4.4 DESIGN CRITERIA - CULVERTS. In general, culverts are used to carry runoff from an open channel or ditch under a roadway to a receiving open channel or ditch. The minimum culvert diameter shall be 15-inches for driveway ditches and 18-inches otherwise. All culvert crossings shall be designed to handle the 100 year flood event. All culvert crossings under arterial roads shall not have any road overtopping. Any other road overtopping shall be limited by the velocity/depth product and as detailed in Section 3.4.2.

A culvert entrance blockage factor of up to fifty (50) percent should be used for small diameter culverts (< 60 inches) and culverts placed in drainages with upstream debris (the County representative or his designee must be consulted on each of these cases before final design). The 100-year flood event backwater surface profile upstream of the culvert will be determined using Washington County approved method (i.e. HEC-2 or HEC-RAS) unless otherwise not required by the County. The back water must be shown to be non-damaging and be approved by the affected property owner(s). Potential paths of embankment overtopping flows will be determined and redesigned to mitigate or eliminate the potential problem, so that no significant flood damage occurs. Appropriate entrance and exit structures must be installed to minimize erosion and maintenance. The minimum culvert slope shall be 1 percent unless otherwise approved by the County representative or his designee.

3.4.5 DESIGN CRITERIA - BRIDGES. Bridges consist of major structures carrying water from major washes or drainage areas. The roadway facility handled can be any classification of roadway. Low water crossings are generally not permitted. Bridges can consist of free span structures, box culvert, multiple box culverts, multiple precast bridge sections and others.

Free-span bridges must pass the 100-year flood event with a minimum of two feet of freeboard. No significant increases are allowed in upstream water levels (no upstream property damage or overtopping of embankments). A Washington County approved method (i.e. HEC-2 or HEC-RAS) of analyzing for the potential upstream water surface may be required by the County. A scour analysis will be required on all bridges that encroach on the natural watercourse. The analysis will discuss the problems associated with scour around and upstream and downstream of the bridge and any mitigation that may be required.

For structures crossing FEMA designated flood plains and drainage, other state

and/or federal requirements may be required, please consult the Washington County representative or his designee.

3.4.6 DESIGN CRITERIA - CHANNELS

3.4.6.1. OPEN CHANNELS. There are two types of open channels; they are manmade and natural. Natural channels can be further subdivided into several sub-categories such as un-encroached, encroached, partially encroached, bank lined and others. The100-year flood event will be used for the design of all open channels unless otherwise approved by the County representative or his designee. All open channels must be designed as permanent structures and have a minimum freeboard of one (1) foot at all points, including bends. They must be designed to be low maintenance facilities and must have adequate access for their entire length.

3.4.6.2. MAN-MADE CHANNELS. Man-made channel side slopes will generally be limited to a maximum slope of 3H:1V. Flatter slopes are generally recommended for maintenance and safety reasons. Safety is a primary concern. A channel should be designed such that a person falling into it could climb out within a reasonable length. A channel that is shallow in depth or in remote areas, or in areas of restricted right of way may, upon approval, have steeper side slopes. Maximum velocities will depend on the type of material used for the channel lining. Supercritical velocities are not permitted for any material used. Drop structures and other energy dissipating structures may be required to limit velocities to control erosion and head cutting.

Maximum velocities for turf lined channels depend on the type(s) of turf mixture used. The designer should consult appropriate design literature for design details on turf lined channels. The minimum bottom width of a turf lined channel will be 6 feet unless otherwise approved by the maintenance agency. The minimum bottom width of all man-made channels shall be designed to facilitate access and maintenance.

3.4.6.3 NATURAL CHANNEL. The use and preservation of natural drainage ways shall be encouraged. Natural channels for drainage conveyance can reduce long term maintenance costs, can reduce initial costs associated with drainage, and can enhance passive recreation, and open space uses. When natural channels are incorporated into the drainage control plan, consideration shall be given to the impact of increased flows resulting from improvements (i.e. new housing developments, commercial and industrial developments, etc.) to upstream drainage basins and areas. The development or land use must provide for adequate access for maintenance and debris removal, long term degradation and erosion potential, and the need for additional set-backs for structures.

3.4.7 STORAGE FACILITIES. Generally, there are two types of storm water runoff storage: retention and detention. Retention ponds are normally intended for infiltration of stored runoff water and may require extensive subsoil and groundwater studies as part of the design. The retention pond will require a higher level of maintenance and has additional safety concerns associated with it and will generally not be allowed.

Detention facilities (basins) are used to temporarily store runoff and reduce the peak discharge by allowing flow to be discharged at a controlled rate. The controlled discharge rate is based on either downstream channel carrying capacity, or the pre-development storm water runoff amount, or in some instances both.

Regional detention facilities are those identified by the County and may be identified in regional drainage studies. Generally, these facilities control flow on major washes or drainage basins, are of major proportion, and are built as part of major development or mitigation plans.

Local detention facilities are usually designed by and financed by developers or local property owners desiring to improve their property. These facilities are intended to allow development of property by protecting a site from existing flooding and/or to protect downstream property from increased runoff caused by development. In small facilities, detention storage volume may be provided in small landscaped or turfed basins, parking lots, underground vaults, excess open space, or a suitable combination. In larger facilities, dual functions may be served. These larger facilities are required to reduce existing flooding to allow a development and/or control increased runoff caused by the development itself. These larger facilities may store significant flood volumes and may handle both off-site and on-site flows.

3.4.7.1 DESIGN CRITERIA - Detention facilities will generally be used to prevent local increases in the 10-year, seventy two hour and the 100-year, seventy-two hour peak flows, or the 100-year three hour storm, whichever case requires the largest volume. Post-development discharges should not exceed pre-development discharges. If downstream facilities lack adequate capacity to handle the flow, other release rates can be required by the County.

Standard hydrologic analysis and engineering practice shall be used in determining the volume of the required facilities. A minimum of one (1) foot of freeboard is required above the maximum water surface elevation of a retention or detention pond. Emergency spillways or other overflow structures will be incorporated into all designs. Structures and facilities shall be designed so as not to be damaged in case of emergency overflow. Detention basins must empty within 24 hours. The maximum depth of a

detention basin should be 3 feet unless otherwise approved by the Washington County representative or his designee. Below grade basins are preferred. Partially wet basins may be allowed for recreational or aesthetic purposes, but storage below permanent spillways or low-level outlets cannot be included in control calculations. Ground water should not be introduced into detention basins without approval of the County. Multi-use (e.g. recreation) should be considered for all detention basins.

Energy dissipation and erosion protection is required at all outlet structures where storm water runoff is released into a natural or erodible channel, unless otherwise approved by the Washington County representative or his designee. All basins are required to function properly under debris and sedimentation conditions. Adequate access must be provided to allow for cleaning and maintenance. All basins shall be designed as permanent facilities unless otherwise approved in writing by the County.

3.4.8 FLOODPLAINS. Flood plains are generally classified as FEMA (Federal Emergency Management Agency) and non-FEMA. Any work in and around FEMA designated and mapped Flood plains should refer to the local ordinance governing their use.

In general, all building floor levels should be constructed two feet above the 100-year flood water level. Encroachments into the 100-year flood plain for all natural watercourses will not be permitted unless approved by the County. All natural drainage washes, and waterways that convey a developed 100-year flow of greater that 150 cfs will be left open unless otherwise approved. Developments located adjacent to or in flood plains may be required to stabilize the degradation and erosion of the channel by installing grade control structures and/or by other effective means. Any alteration of the flood plain is not permitted unless the proposed use can be shown to have no significant negative influence on the flood conveyance, the flood plain water level, or the alteration itself.

In the layout and design of new developments, adequate access to flood plains and erosion protection shall be provided. It is preferred that streets be positioned between flood plains and development structures. Where not possible or feasible, additional structural setbacks will be required.

Hydrologic, hydraulic, erosion, and geomorphologic studies will be required of developments adjacent to Flood plains. The County may require the placement of Flood plain or Flood way delineation signs along the boundary of lots impacted by the Flood plain or Flood way to assist in future monitoring of the Flood plain or Flood way.

3.4.9 EROSION CONTROL. Necessary measures shall be taken to prevent erosion due to drainage at all points in new developments. During grading and construction, the developer shall control all potential storm runoff so that eroded

soil and debris cannot enter any downstream water course or adjoining property. All drainage that leaves a new development shall be adequately addressed to mitigate all erosion on adjacent properties and any increased flow due to development. Erosion mitigation shall be a permanent part of the final development plans unless otherwise approved.

3.4.10 IRRIGATION DITCHES. In general, irrigation ditches shall not be used as outfall points for storm runoff drainage systems, unless such use is shown to not affect the performance of the ditch for its original intended use when substantiated by adequate hydraulic engineering analysis.

3.4.10.1 USE OF DITCHES - The irrigation ditches running through the area are laid out on very flat slopes and with limited carrying capacity. It is obvious, based on experience and hydraulic calculations, that irrigation ditches cannot, as a general rule, be used as an outfall point for storm water drainage because of physical limitations. Exceptions to the rule are when the capacity of the irrigation ditch is adequate to carry the normal ditch flow plus the maximum storm water runoff with adequate freeboard to obviate creating a hazard to those below and around the ditch. Ditches are almost always totally inadequate for use as drainage ways.

Irrigation ditches are sometimes abandoned in areas after the agricultural land is no longer farmed. Provisions must be made for ditch perpetuation prior to its being chosen and used as an outfall for storm water drainage. Use of irrigation ditches for collection and transportation of storm water runoff shall be made only when approved by the Washington County representatives or his designee.

3.4.10.2 Irrigation Company Approval. Any use of, alteration of, or relocation of structures on any irrigation ditch (or canal) shall have the written approval of the irrigation company who shall take the responsibility thereof.

3.4.11 WATER QUALITY CONTROL - Storm water may be considered a non-point source of pollution. It can carry materials that may cause unwanted physical, chemical, and biological changes in receiving waters. As such, a development should construct storm water facilities to control pollutant concentrations and mass loadings discharged into receiving water systems. Some water quality parameters resulting from material transported in storm water that are of concern are sediments, hydrocarbons and oils, oxygen demand, bacteria, nutrients (carbon, nitrogen and phosphorus), metals and other toxic chemicals. Receiving waters can assimilate only a limited quantity of different storm water materials. After a threshold is reached, the material becomes a pollutant that can result in an undesirable impact on the receiving water.

Federal and state regulations may limit pollutant concentration and mass loading

to receiving waters from non-point sources. Any required permits and notices (i.e State Notice of Intent) shall be obtained prior to issuance of a grading permit. Technical considerations in design should be given to prevention or reductions of non-point sources of pollution by developments. Consideration should be given to the use of storm water management systems within developments that will reduce non-point sources of pollution such as off-line retention (infiltration) ponds, sedimentation ponds, wetlands that pass storm water through them, and reuse ponds. A goal for development should be to provide a storm water system that will have post-land-use mass loadings that are equivalent or less than pre-land-use mass loadings.

3.5 SANITARY SEWER DESIGN. This sub-section sets forth the criteria for engineering design of wastewater collection systems. All wastewater lines shall be designed to be located in roadways or other vehicle travel ways unless approved by the County Representative.

Minor additions, renovations and repairs to an existing sewer or plumbing system shall be permitted in the same manner and arrangement as in the existing system, provided that such repairs or replacements are not hazardous and are approved by inspection. All sewer main lines installed in public or private streets shall be inspected in accordance with these Standard Specifications for Design and Construction. These lines are public lines unless otherwise approved by the County Representative.

3.5.1 DESIGN FLOWS. All sanitary sewers and appurtenances shall be designed to carry the design flows from all contiguous areas which may, within a reasonable period in the future, be tributary thereto. Trunk lines shall be designed in accordance with any applicable system master plan.

Sanitary sewers shall be designed to carry the peak discharge as specified below; also, all sewers shall be designed to transport suspended material so as to preclude the deposition of any solids in the sewer line.

New sewer systems shall be designed on the basis of an average daily per capita flow of not less than one hundred gallons per day. Other flow rates, based on accepted engineering practice, may be submitted to County's Representative for review and/or approval. Sanitary sewer systems shall be designed to prohibit infiltration and exfiltration. To provide for peak loads, sanitary sewers shall be designed to carry not less than the flow shown in Table 3.9 when running 2/3 full.

TABLE 3.9
SANITARY SEWER DESIGN FLOWS

Laterals and sub mains gallons/capita/day	400
Mains, trunks and outfalls gallons/capita/day	250

All sewers shall be designed and constructed with hydraulic slopes sufficient to give average daily cleaning velocities of not less than two (2) feet per second, based on Manning's formula. As a minimum, Manning's "n" value shall be in accordance with pipe manufacturer's recommendation. An "n" value which will yield higher friction losses shall be used where disturbing influences are known or anticipated, such as disruption of flow by tributary inflows, varied pipe materials, etc. The minimum slopes to be provided shall be as shown in Table 3.10, unless approved otherwise by the County representative.

TABLE 3.10
SANITARY SEWER MINIMUM SLOPES

SEWER SIZE (Inches)	MINIMUM SLOPE (ft/100 feet)
4	2.00
6	1.00
8	0.50
10	0.40
12	0.35
15	0.30
18	0.25
21	0.20
24	0.15

Under special conditions, when justifiable reasons are given, slopes slightly less than those required for the two feet per second velocity when flowing one half full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for the design average flows, and where computations of the depth of flow in such pipes at minimum, average and peak rates of flow are submitted showing the basis of design. The Design Engineer must furnish computations for velocities and depth of flow for grades in excess of ten percent (10%) and for extremely low flow situations.

Hydraulic jumps shall be avoided whenever possible. Where velocities greater than fifteen (15) feet per second are attained, special provision shall be made to protect against displacement by erosion and shock.

3.5.2 MINIMUM SIZE AND DEPTH. No public sanitary sewer shall be less than eight (8) inches in diameter. Minimum size of house connections shall be four inches in diameter. Minimum size of commercial connections shall be six inches in diameter. Only one residence, structure, or building shall be served by each lateral connected to the public main (Uniform Plumbing Code, Chapter 3).

Lateral size and slope shall be based on the number of fixture units. Up to ninety (90) fixture units may be allowed per four (4) inch lateral line if the slope and capacity are adequate. Each lateral connected to the public main shall serve only one residence, structure, or building. No connection of any sewer lateral to buildings or structures will be allowed until all downstream sewer lines have been

tested and passed and all associated manholes have been raised and collared at asphalt grade.

In general, sanitary sewers shall be designed to a minimum depth of nine (9) feet to the pipe invert in order to facilitate basements. Depth of pipe shall be measured from top of back of curb at low side of property to be served, in order to permit sewer laterals from basements to be connected. Exceptions may be granted in subdivisions or areas in which houses without basements are to be constructed. In such case a note to that effect shall be made on the plat map and on all plans presented for approval. In no case shall sanitary sewers be designed for a depth of cover less than thirty six (36) inches over the top of the sewer pipe. All sewers shall be designed to prevent damage from super-imposed loads as well as trench loading conditions. When more shallow depths are unavoidable, consideration for approval may be given upon submittal of proper engineering design criteria to the County representative.

3.5.3 ALIGNMENT. All sanitary sewer mains shall be designed for uniform slope and alignment between manholes and shall be laid a distance of at least ten (10) feet (horizontally) from any existing or proposed water main. In the event that a sewer main cannot be laid at least ten (10) feet from an existing or proposed water main, then the County's Representative may authorize the implementation of the provisions of the appropriate section of the State of Utah Public Drinking Water Regulations.

All sewer laterals shall intersect the sewer main on the top third of the sewer main pipe as shown in the standard drawings.

3.5.4 SERVICE CONNECTIONS. Service connections to any public sanitary sewer shall be made only to a wye installed at the time of the sewer main installation or by a machine tap and approved saddle compatible with the main line sewer material in accordance with the standard drawings. Service connections shall be a minimum of ten (10) feet, measured horizontally, from any culinary water line. All connections and service lines must be water tight. All sewer clean-outs shall be made with standard wye fittings. New subdivisions shall install a sewer lateral from the main sewer to each proposed lot. The lateral shall be located fifteen (15) feet from the low side lot line, unless otherwise approved, and shall extend a minimum of ten (10) feet into the property. All lateral cleanouts on new construction shall extend two (2) feet above top back of curb or finished grade with a glued on cap.

Service connections shall not be made to any sewer outfall line with a diameter greater than fifteen (15) inches unless otherwise approved by the County's Representative.

All sewer laterals connected to public sewer mains shall conform to Table 3.11. Laterals shall not be connected into main line stub ends extending from

manholes.

All restaurants, food service establishments and other buildings that use high amounts of grease or oil shall install grease traps approved by the County's Representative and shall comply with any County "pretreatment" standards. Multiple connections to a lateral are not permitted.

Under no circumstances shall swimming pool drains, roof drains, foundation drains, storm drains or sub-drains be connected to the sanitary sewer system.

TABLE 3.11
SANITARY SEWER LATERALS

TYPE OF UNIT OR RESIDENCE	MINIMUM SEWER LATERAL SIZE (Diameter)	MINIMUM SLOPE
Single Family Residences	4 inches	2%
Townhomes (each unit)	4 inches	2%
Commercial establishments	6 inches	1%
Mobile Homes	4 inches	2%
Apartments & multifamily condominiums	**4 inches minimum (see note below)**	

NOTE:
1) Lateral size and slope shall be based on the number of fixture units in the apartment or condominium, in accordance with the Uniform Plumbing Code.

3.5.5 MANHOLES. Manholes shall be installed at all changes in grade, direction, pipe size or at all intersections; and at distances no greater than four hundred (400) feet apart. All manholes shall be accessible to maintenance vehicles, and all sewer easements shall provide at least twelve (12) feet of unobstructed width. Drop manholes shall be provided for a sewer line entering a manhole at an elevation of two (2) feet, or more, above the manhole invert. Floor troughs shall be furnished for all sewers entering manholes, and shall be at least as deep as the full diameter of the sewer main in the manhole. Lines entering a manhole above the main trough but less than twenty-four (24) inches above the invert shall be provided with a slide inside the manhole to prevent sewage from getting into the manhole shelf and to minimize splashing of sewage.

A sewer main or service eight inches or larger connecting to an existing sewer main shall require a manhole at the point of connection. Where the junction consists of the same size sewers, a 0.2 foot drop shall be provided between the branch and main sewer. When a smaller sewer main joins a larger sewer main in a manhole, the top of pipe elevations shall match.

All manholes shall have eccentric manhole cones conforming to the detailed dimensions, construction details and materials as shown in the standard drawings.

Sewer manholes for all sewer mains of less than twelve (12) inches in diameter shall be a minimum forty-eight (48) inches inside diameter. For sewers mains twelve inches in diameter or larger or over twelve (12) feet in depth, the manholes shall be not less than sixty (60) inches in inside diameter. When the sum of all pipe sizes connecting to the manhole totals 24 inches or greater, the manhole diameter shall be sixty (60) inches or greater.

When a sewer line is installed in a development or in a phase of a development, the line may be extended up to three feet beyond the last manhole on the line. The open end of the extension (the "stub") shall be the bell end of the pipe and must be sealed with a water-tight plug to allow for future extension. The stub shall be grouted and sealed around the pipe as it exits the manhole, to promote a water-tight fit.

Manhole sections shall be installed no less than 14 days after date of manufacture. Each manhole section shall be clearly marked on the inside with the name of the manufacturer and the date it was manufactured.

3.5.6 UTILITY CLEARANCES. The following clearances must be maintained between sewer lines and other utilities unless otherwise approved by the County Representative:

A. Utility clearances specified in applicable laws and codes shall be adhered to.

B. Sewer mains should be placed lower than other utilities.

C. Water distribution and sewage collection lines shall be laid in separate trenches, with at least ten (10) feet of separation measured horizontally.

D. Where the water line is less than eighteen (18) inches over the sewer line, where the water line is under the sewer line, and where the horizontal separation cannot be maintained because of physical obstructions, the water line shall be protected by construction of the sewer line with 1) ductile iron pipe; 2) water supply quality materials and joints; or 3) encasement with a minimum of two (2) inches of concrete. Each of these provisions shall extend ten feet on each side of the crossing. These provisions shall also be extended for other than ninety degree crossings to the point at which the ten (10) foot separation between the water and sewer lines is achieved.

E. Sewer laterals and mains crossing under power, gas, storm drain,

telephone, traffic signal conduit and/or street lighting conduit shall have at least one (1) foot separation, measured vertically. If the required vertical clearance cannot be met, a cushion of sand and cement slurry may be used to separate the utilities, upon approval of the County Representative. Where use of sand and cement slurry are not practical, the Engineer may propose alternate methods.

F. The following horizontal clearances should be maintained between utilities:

- Water to phone lines/cable TV - five (5) feet
- Water to gas - five (5) feet
- Water to power - five (5) feet
- Culinary water to irrigation (secondary water) - ten (10) feet
- Water to sewer - ten (10) feet
- Water to water – three (3) feet
- Gas to power - ten (10) feet.
- Gas to sewer – five (5) feet

3.5.7 SUSPENDED CROSSINGS. When suspended crossings are required, adequate support shall be provided for all joints in the pipe utilized for the crossings. The supports shall be designed to prevent frost heave, overturning and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. For suspended crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the one hundred year flood plain. When possible, the crossing supports shall be designed to allow for future adjustment in grade.

3.5.8 PRESSURE (FORCE) SEWER MAINS. The following defines design criteria and standards for pressure mains.

A. **Velocity:** A velocity of no less than three (3) feet per second shall be achieved at design flow. Calculation of pressure main velocity, design pressure, and hydraulic losses shall be submitted to the County's Representative for approval.

B. **Air Relief Valves:** Where required, an automatic air relief valve specifically designed for raw sewage application(s) shall be placed in the force main to prevent air locking.

C. **Slope:** To limit accumulations of gases, no segment of a force main shall have a zero slope. Wherever possible, low points which are subject to solids accumulation shall be avoided.

D. **Termination:** Pressure mains shall enter the gravity sewer system at a manhole. If necessary, provisions shall be made to direct or baffle sewage

as it enters the manhole.

E. **Design Pressure:** The pressure main and fittings, including reaction blocking, shall be designed to withstand normal pressure, pressure surges (water hammer), and total (active and passive) earth loads.

F. **Suspended Crossings:** Pressure mains used for suspended crossings shall meet applicable requirements of SECTION 3.5.7.

G. **Hydraulic Losses:** Friction losses through pressure mains shall be based on the Hazen-Williams formula. For the Hazen-Williams formula, "C" = 100 shall be used for unlined iron or steel and "C" = 120 for all other materials. Turbulent losses at fittings, bends and valves shall be determined in a similar manner. The design data shall be submitted to County's Representative for review and prior approval.

H. **Thrust Blocks:** Thrust blocks and other restraints shall be included as necessary to secure the pressure main from movement.

I. **Identification Ribbon:** A pipe locator ribbon shall be placed no less than eighteen (18) inches above the top of pipe, centered along the entire length of the pressure main. The ribbon shall be green in color and shall have the clearly printed legend, "Buried Sewer Line Below", printed continuously along its length with minimum one inch letters. The ribbon shall be not less than two (2) inches wide. For nonmetallic pressure mains, the locator ribbon shall have a metallic component, such as plastic-coated aluminum.

3.5.9 CONNECTION INTO EXISTING SYSTEMS: When connecting any sewer main or sub-main into an existing sewer system a plug shall be installed at the time the sewer is cut into, both on the downstream and upstream ends of the new line. The plug shall be a Cherne Gripper Mechanical Plug, or approved equal. The plugs shall not be removed until the new sewer system is approved and accepted by the County's Representative.

3.6 CULINARY WATER DESIGN. All culinary water mains and appurtenances within Washington County shall be designed to provide for adequate future service for all contiguous areas which may, within a twenty year period in the future, be tributary thereto. Water trunk lines shall be designed in accordance with any applicable system master plan.

3.6.1 DESIGN FLOW PRESSURE. Water mains shall be designed to provide a minimum residual pressure of twenty (20) psi under maximum day demand conditions including designed fire flow (as called out in SECTION 3.6.7 of these Standards). A minimum of forty (40) psi residual pressure must be maintained under normal peak hour conditions without fire flow, as measured at the "County"

side of the service connection (at the right-of-way line).

3.6.2 FLOW DESIGN CRITERIA. Flow design criteria shall conform to the requirements outlined in the current edition of the State of Utah Rules for Public Drinking Water Systems. In any case where these specifications require a higher design standard than is contained in the referenced Rules, the higher design standard shall take precedence.

Commercial or industrial areas may require special investigation to determine fire flow requirements. Existing and future static pressure and flow information used in the design must be approved by the County representative.

3.6.3 MINIMUM SIZE AND DEPTH. The minimum depth of cover (to the top of the pipe) for water mains shall be three (3) feet below subgrade of the street, or one (1) foot below the frost line whichever is greater with a maximum of six (6) feet unless otherwise approved by the County representative. Where final grades have not been established, mains shall be installed to a depth great enough to ensure a minimum of three (3) feet and a maximum of six (6) feet of cover below future subgrade. The water mains shall be sized to deliver the peak instantaneous flow rate as previously outlined. The fire flow requirements and pressures shall be as previously outlined. The minimum water main size to be installed shall be eight (8) inches in diameter unless otherwise approved by the County representative.

Departures from the minimum requirements will be considered only in special circumstances. Any departure from minimum requirements identified above shall be justified by a network hydraulic analysis. Water mains in cul-de-sacs, short internal streets within subdivisions, and other areas where water mains will not be extended in the future and are not connected to fire hydrants, may be six inches in diameter if that size water main meets the water demand requirements as shown by a network hydraulic analysis.

3.6.4 VALVES AND HYDRANTS. The water system shall be looped and valves shall generally be spaced such that a break in any one length of main will put no more than one thousand (1000) feet of main or more than two fire hydrants out of service (whichever is less) while maintaining adequate minimum service in the remainder of the water system during repairs, except for major transmission lines, where longer spacing may be allowed. All distribution mains connecting to larger transmission mains shall have a valve installed at the connection. All fire hydrant runs shall also have the valve installed at the distribution main unless otherwise directed by the County Representative. Valves shall generally be located at street intersection with four (4) valves at a cross intersection and three (3) valves at a Tee intersection.

3.6.5 PRESSURE REDUCING VALVES. Pressure reducing valves and vaults shall be installed on main lines where required. The design for these pressure

reducing valves and vaults shall be approved by the County Representative and the applicable Water Company (see standard drawings for typical PRV installation).

3.6.6 FIRE HYDRANT SPACING AND LOCATION. Fire hydrants shall be spaced and located as per the adopted County Fire Code and generally as follows:

A. At each intersection, generally on the same sides of the street.

B. In residential areas, fire hydrant spacing shall be no greater than five hundred (500) feet and no parcel or lot shall be more than two hundred fifty (250) feet from a hydrant measured along a street access to the property being served.

C. In multiple family areas, PUD zones, P.D. zones, industrial, business or commercial areas, fire hydrant spacing shall require special investigation to determine the hydrant spacing per the current adopted fire code.

D. Generally, hydrants shall be located in line with extensions of the property line when located mid-block.

E. Hydrants shall be placed no more than five (5) feet from the back of the sidewalk. Where sidewalk is not adjacent to the curb and a four (4) foot wide or wider planter area exists, the hydrant may be placed in the planter no closer than two feet from the back of the curb. Provide a five (5) foot elliptical radius of clearance from any point on the fire hydrant to adjacent obstacles with the lowest water outlet not less than eighteen (18) inches or more than thirty (30) inches from the final ground elevation (see standard drawings). The "break-away" flange at the bottom of hydrants shall be installed so that it is at, or within six (6) inches above, final ground elevation.

F. All fire hydrants shall be owned and maintained by the applicable Water Company and shall be installed on dedicated easements or public rights-of-way**.**

G. A fire hydrant shall be placed in the end of all cul-de-sacs or on dead end lines.

H. Fire hydrants shall not be located within five (5) feet of a driveway, power pole, light standard, block wall, fence, or any obstruction.

3.6.7 FIRE FLOW REQUIREMENTS. Under maximum day demand conditions, fire flow shall be at least one thousand (1,000) gallons per minute at any one hydrant and must meet the requirements of the currently adopted Fire Code. The total system design shall be such that fire flows and normal peak daily flow

demand can be met while still maintaining a minimum pressure of twenty (20) psi at all points in the distribution system.

A maximum water velocity of ten (10) feet per second should be utilized when designing for fire flows and/or other emergency conditions.

High density residential, commercial or industrial areas shall require special investigation to determine fire flow requirements and hydrant spacing per the currently adopted Fire Code.

Existing and future static pressure and flow information used in the design shall be approved by the County Representative and applicable Water Company.

3.6.8 MISCELLANEOUS WATER SYSTEM DESIGN CRITERIA.

A. All public water mains shall be installed in a public right-of-way, dedicated roadway, or approved easement, with adequate access for maintenance vehicles. Pipelines will not be installed on back lot or side lot lines due to potential flood and other damage, unless otherwise approved by the County Representative.

B. Dead-end mains shall be avoided wherever possible and if installed, shall not exceed six hundred (600) feet. Hydrants shall be located at the end of dead-end mains and cul-de-sac mains for flushing purposes as well as for fire protection.

C. Each building or lot shall be served by a separate line and meter. All lots shall have a minimum of three quarter (3/4) inch service line from the main to the meter box. Multiple housing of two units, or more, shall have a minimum of one (1) inch service. When there are more than two multiple housing units the service line shall be sized accordingly.

D. All service line taps shall be machine tapped at the time of the water main installation. Service lines shall be installed prior to testing and acceptance of the water main.

E. Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed wastewater main. The distance shall be measured edge to edge. If the required separation cannot be maintained, then where approved by the County's Representative, options found in the State of Utah Public Drinking Water Regulations may be implemented.

F. When a water main crosses over a wastewater main, the water main shall be laid at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the wastewater main. When the water main cannot be as high as eighteen (18) inches above the wastewater

main, the wastewater main shall be constructed of material with pressure conduit standards for a distance of ten (10) feet on either side of the crossing as required by the State of Utah Public Drinking Water Regulations.

G. All tees, bends, plugs and hydrants shall be provided with reaction blocking, tie rods, and/or joints designed to prevent movement, i.e. “mega lug" or approved equal. Wood blocking of future main extensions is not acceptable. When thrust restraints cannot be used, concrete thrust blocks shall be formed and poured in place and must bear against undisturbed soil, per the thrust block details in the standard drawings. Installation of concrete thrust blocks shall receive prior approval of County Representative and applicable Water Company.

H. Air release vacuum assemblies and blow-off valves shall be provided on all mains twelve inches in diameter and larger, where required, to prevent damage due to air accumulations.

I. All water lines shall require a twelve (12) gauge solid copper wire with PVC or PC insulation be installed with the line for locating purposes. The wire shall be installed and extended up at each valve, hydrant, and up each service into the meter box.

J. Sufficient valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. Valves shall be generally located as follows:

(1) At intervals to isolate no more than two (2) fire hydrants at any time.

(2) At minimum intervals of five hundred (500) feet in commercially zoned areas.

(3) At minimum intervals of six hundred (600) feet in residential areas.

(4) A maximum of five (5) valves will be required to isolate any location.

(5) Valves shall not be located in street gutters, valley gutters, or in driveways.

(6) A valve is required at the end of all temporarily dead-ended mains. The valve location is to be a minimum of ten (10) feet upstream of the cap.

(7) Valved outlet(s) for future service laterals six (6) inches in diameter and larger may be installed when approved by the County representative. (Valved outlet installation approval does not constitute a

water commitment.)

(8) A shut off valve immediately adjacent to the water main shall be provided for all service laterals greater than two (2) inches in diameter and for all fire hydrant laterals.

(9) The County representative may require additional valves as deemed necessary.

3.6.9 NETWORK HYDRAULIC ANALYSIS.

3.6.9.1 WHEN REQUIRED. The County representative may require that a network hydraulic analysis be conducted by the Engineer if any of the following conditions apply:

A. The project is a major subdivision with an internally looped system.

B. The project is located in the higher elevations of a low static pressure zone.

C. A high fire flow demand is required (greater than1500 gallons per minute).

D. There will be extensive irrigation.

E. The new water plans will complete a loop on the current system.

F. As otherwise required by the Water Department County representative.

3.6.9.2 DESIGN. The consulting engineer should request the source hydraulic grade line (HGL) from the applicable water company prior to the initial design where a network hydraulic analysis is required. The following information shall be submitted at the time of such a request:

A. Location, type of development, and the acreage or number of units with the development.

B. Anticipated fire flow requirements.

C. The location where the proposed water distribution system is planned to tie into the existing system.

3.6.9.3 SUBMITTAL FOR REVIEW AND APPROVAL. The network hydraulic analysis shall be submitted with the project design for review. For larger projects, such as a major subdivision, obtaining network hydraulic

analysis approval prior to submitting the water plan is preferred.

The network hydraulic analysis submittal shall include two copies of the following items:

A. The data input sheets, as well as the analysis results.

B. Information about the development (i.e., type, number of acres, number of units, fire flow requirements, etc.).

C. Data sheet(s) outlining all assumptions (i.e., method used to assign demands to corresponding nodes and source HGL's used).

D. Map identifying pipe and node numbers and their locations.

E. Fire hydrant locations.

F. The name and version of software used for the analysis.

G. Elevations of junction nodes.

H. Staging or phasing of development.

I. Appropriate off-site demands.

3.6.9.4 MISCELLANEOUS. The roughness factors to be used in the analysis should be as follows:

A. C equal to 100 for all unlined cast iron pipe.

B. C equal to 120 for existing pipe twelve inches, or less, in diameter.

C. C equal to 130 for existing pipe (150 for PVC or HDPE) fourteen inches, or greater, in diameter.

D. C equal to 130 for new pipe (150 for PVC or HDPE) regardless of diameter

For any other sizes or materials not covered by the above, the consulting engineer shall contact the applicable water company for guidance.

When identifying the fire flow available in a network hydraulic analysis, use the hydrant located at the development's weakest point (highest point in the development and/or last hydrant on dead-end main). Also, verify the hydrant is located at a junction node.

The elevations used in the network hydraulic analysis should be based on a project grading plan or the anticipated final elevation. If the final grading plan deviates significantly from the elevations used in the analysis, a revised analysis will be required. The analysis shall evaluate any adverse affects on the existing water system.

3.7 SECONDARY WATER OR WASTEWATER REUSE IRRIGATION SYSTEM. All secondary water irrigation systems shall be designed and constructed in accordance with the requirements outlined for culinary water systems in SECTIONS 3 and 4 of these specifications. However, all valve box covers and service connection covers shall bear the legend "Irrigation" in order to clearly differentiate between culinary and secondary systems. The pipe material shall be colored purple, or have continuous purple markings meeting applicable standards. There shall be no cross connections between secondary and culinary water systems.

All wastewater reuse irrigation systems shall be designed and constructed in accordance with the requirements outlined for culinary water systems in SECTIONS 3 and 4 of these specifications. However, all requirements for the treating and reuse of wastewater outlined in the latest applicable Utah Division of Water Quality Standards for Utilization and Isolation of Domestic Wastewater Treatment Works Effluent shall be followed. These requirements include, but are not limited to, a reuse project plan, allowed uses, required treatment processes and water quality limits.

3.8 OTHER UTILITIES SYSTEMS DESIGN. All other utility systems shall meet the following:

3.8.1 RESPONSIBILITY. Other necessary utility installations (Gas, Electricity, Phone, and T.V.) will be coordinated and installed by the developer.

3.8.2 BURIAL OF LINES. All utility lines in subdivisions, planned unit developments, and other developments shall be underground. Lines shall be buried at a minimum depth of forty-two (42) inches for primary power. Power lines shall not be buried in any water or sewer trench.

3.8.3 LAYOUT. Utility lines shall be located within designated utility easements and in accordance with the requirements of the Washington County Staff Meeting (WCSM) and applicable utility companies

3.8.4 FRONT LOT LINE SYSTEMS. Where utilities are located in front lot lines, other utility system construction shall not begin until the completion of water, sewer, curb and gutter, and must be complete before installation of street asphalt.

3.8.5 QUALITY CONTROL. All utility trench construction shall conform to the

design and testing requirements set forth in Section 4.4 (Pipeline Construction) of these standards.

3.9 TRAFFIC STANDARDS. This sub-section sets forth the criteria for access control and Traffic Impact Studies.

3.9.1 ACCESS CONTROL. The general access control requirements for arterials and collectors are provided below. All access points on these facilities shall be subject to approval by the County representative. Where deemed necessary, stricter requirements may be invoked.

3.9.1.1. GENERAL REQUIREMENTS. Direct access to a residential lot from an arterial or collector road shall not be allowed unless otherwise approved by the County representative. If allowed, additional requirements and restrictions may be imposed such as increased setbacks, circular drives, etc.

A. Driveway access should not be allowed within one hundred fifty (150) feet of the nearest curb line of an intersecting street for collectors and two hundred (200) feet for arterials (see section 3.2.4) unless preapproved.

B. Unless otherwise approved by County representative, access shall be limited to one driveway for each tract of property separately owned. Properties contiguous to each other and owned by, or previously owned by, the same party are considered to be one tract.

C. Driveways giving direct access may be denied if alternate access is available.

D. When necessary for the safe and efficient movement of traffic, access points may be required to be designed for right turns in and out only and will include appropriate deceleration and turning lanes.

E. When approved, or directed by the County representative, a driveway access design may be a "street type intersection" with curb returns.

3.9.2 TRAFFIC IMPACT STUDIES. A Traffic Impact Study, (TIS) is a specialized study of the impacts that a certain type and size of development will have on the surrounding transportation system. It is specifically concerned with the generation, distribution, and assignment of traffic to and from the “new development”. The term “new development” also includes properties that are being redeveloped.

A Traffic Impact Study shall be required for all new developments or additions to existing developments which generate 100 or more trips during the morning or

afternoon peak hours or which will have a significant impact on the County's transportation system as determined by the County representative. Traffic Impact Studies are divided into three categories. The scale of development will determine which category of study will be required. Each category differs by specific analysis requirements for the study and the study's level of detail. Below is a description of each category.

CATEGORY I -- Developments which generate 100 or more new peak hour trips, but less than 500 trips during the morning or afternoon peak hours. Peak hour trips will be determined by ITE's Trip Generation Manual.

In addition to the above threshold requirements, a Category I TIS may also be required by the County representative for any specific traffic problems or concerns such as:

- proposed or existing offset intersections;
- situation with a high number of traffic accidents;
- driveway conflicts with adjacent developments;
- nearby intersections that have reached their capacity;
- proposed property rezones when there is a significant potential increase in traffic volumes;
- when the original TIS is more than two years old, or where the proposed traffic volumes in the original TIS increase by more than twenty percent.

For a Category I TIS, the study horizon shall be limited to the opening year of the full build-out of the development.

The minimum study area shall include site access drives, affected signalized intersections and major unsignalized street intersections.

CATEGORY II -- Developments which generate from 500 to 1000 new peak hour trips during the morning or afternoon peak hours.

The study horizon shall be for the year of completion for each phase of the development, the year of its completion and five years after the development's completion.

The minimum study area shall include the site access drives and all signalized intersections and major unsignalized street intersections within one-half mile of the development.

CATEGORY III -- Developments which generate above 1000 new peak hour trips during the morning or afternoon peak hours.

The study horizon shall be for the year of completion for each phase of the development, the year of its completion, five years after the development's completion, and ten years after the development's completion.

The minimum study area shall include the site access drives and all signalized intersections and major unsignalized street intersections within one-half mile of the development.

The County Representative, or his designated representative, shall make the final decision of requiring a TIS and determining whether the study falls within Category I, II, or III.

The TIS shall be conducted and prepared by a qualified Traffic Engineer. The subject Engineer shall have special training and experience in traffic engineering and be a member of the Institute of Transportation Engineers (ITE).

Generally, the data necessary for such a study will require a description of the study area, the scope of development, turning movement traffic counts, accident analyses, roadway geometry, traffic control devices, and trips generated by the new development. The roadways and intersections within the study area shall be analyzed with and without the proposed development to identify projected impacts with regard to level of service and safety.

Where the road will operate at Level of Service "C" or better without the development, the traffic impact of the development on the roadways, and intersections within the study area shall be mitigated to Level of Service "C" or better. Mitigation to Level of Service "D" may be acceptable with the concurrence of the County. A list of mitigation improvements will be provided in the study to achieve this Level of Service.

The guidelines and specific requirements for the preparation of a TIS are found in the "City of St. George Traffic Impact Study Guidelines". All studies prepared for submittal to Washington County shall follow these guidelines unless otherwise approved.

3.10 SURVEY MONUMENTATION STANDARDS. This sub-section sets forth the general standards for survey monuments.

3.10.1 GENERAL REQUIREMENTS. Only a Land Surveyor, registered in the State of Utah, shall be authorized to determine or establish the exact location for a survey monument. Only such registered Land Surveyor shall be authorized to perpetuate and reference existing Class I and II survey monuments located within the limits of public or private streets.

3.10.2 MONUMENTS. Class I or II monuments shall be set in accordance with the recorded maps so that the survey, or any part thereof, may be readily retraced. Such monuments shall be set at:

A. All angle points in survey boundary (Class II).

B. All angle points of tangency and points of curvature on and along survey boundary (Class II).

C. All street centerline intersections (Class I).

D. At all road P.I.'s that fall within the limits of the pavement area (Class 1). If the P.I. falls outside the limits of pavement then P.C.'s and P.T.'s shall be monumented with Class I instead of the P.I. If the P.I. falls inside the pavement area then a Class I monument is required and no monumentation required for P.C.'s and P.T.'s. If line of sight between monuments is not attainable from P.C. to P.T. then additional Class II monuments may be required.

E. All intersections of street centerlines at survey boundary (Class II).

F. Eight hundred (800) foot intervals along roadway centerlines, unless otherwise approved. If line of sight is not obtainable within a six hundred foot interval, then monuments will be required to be closer together unless otherwise approved by the County Surveyor.

When a section corner, quarter corner or sixteenth corner falls within a fully improved roadway and must be set, or reset, the responsible surveyor shall contact the County Surveyor for directions and/or requirements.

All monuments shall have brass marker or aluminum cap in accordance with the standard drawings. The surveyor's registration or license number shall be stamped on the cap.

Monuments must be set prior to the final acceptance of the improvements.

Where hard rock or other physical obstructions are encountered, monument length sufficient to resist removal may vary within reasonable limits.

All monuments shall be set in such a manner that the accuracy of their relative positions is not less than second-order Class II, in accordance with the specifications established by the U.S. Federal Geodetic Control Committee. When monuments are being reset, the initial order used in the setting shall be used, but in no event shall it be less than second-order Class II.

3.10.3 TYPES OF MONUMENTS. Class I and II monuments shall be installed in accordance with County requirements and as shown in the standard drawings

SECTION 4

CONSTRUCTION STANDARDS

4.1 INTRODUCTION. This section sets forth the requirements for earthwork, pipeline construction, roadway construction, chip seals, slurry seals, concrete work and restoration of surface improvements.

4.2 SURVEY REQUIREMENTS. Prior to commencing the work, all construction shall have appropriate construction staking in conformance with the approved drawings unless otherwise approved by the County representative. The staking shall have all necessary information including, but not limited to, stationing, cut or fill data, off-set distance and invert elevations. The information shall be placed on the face of stakes in a legible manner using weatherproof marking materials and shall be in accordance with general surveying practice. All construction staking shall be under the direction of the Engineer responsible for the project.

When a water main design has a profile with grades, a grade line will be staked at the designated grades prior to installation of any pipe. A laser may be used in lieu of a grade line. All sewer lines and storm drains will require that a grade line, or laser, be set and checked prior to installation of any pipe.

4.3 EARTHWORK. This subsection defines the requirements for excavation and backfill for structures, preparation of embankments and fills, and subgrade preparation for pavement and other surface improvements.

4.3.1 MATERIALS. Earthwork materials shall conform to the following:

4.3.1.1 EXCAVATION. All structures shall be founded on prepared original soil or engineered fill. Unauthorized excavation below the specified structure subgrade shall be replaced with concrete, untreated base course, or approved engineering fill thoroughly compacted to a minimum of ninety-five (95) percent of maximum dry density. Subgrade soil for all concrete structures, regardless of type or location, shall be firm and thoroughly compacted to a minimum of ninety-five (95) percent of maximum dry density for granular soils or ninety (90) percent of maximum dry density for silty/clay (fine-grained) soils, as measured by modified proctor.

4.3.1.2 SUBSOIL REINFORCEMENT. Coarse gravel, crushed stone, or a geotextile may be used for subsoil reinforcement when approved by the County representative. Coarse gravel or crushed stone shall be applied in six (6) inch layers, each layer being embedded in the subsoil by thorough tamping. Approved geotextile shall be installed in accordance with manufacturer's recommendations. All excess soil shall be removed. The finished elevation of any subsoil shall not be above the specified sub-grade elevation.

4.3.1.3 BACKFILL. Backfill shall be placed to the lines and grades shown on the approved drawings, or as directed by the County's Representative. Prior to backfilling any construction work, the excavation shall be cleaned of all forms, trash and debris, and such material shall be removed from the site. Backfill material shall be approved and consist of excavated material or clean imported materials such as sand, gravel or other suitable material.

Backfill shall be placed in layers compatible with the equipment and not exceeding six (6) inches in compacted thickness. Each layer shall be compacted to a minimum density of ninety-five (95) percent of maximum dry density for granular soils or ninety (90) percent of maximum dry density for silty/clay (fine-grained) soils, as measured by modified proctor.

4.3.2 CONSTRUCTION METHODS. The methods employed in performing the work shall be the responsibility of the Contractor. These methods shall include, but are not limited to, the following:

4.3.2.1 CONSTRUCTION OF EMBANKMENTS. Unsuitable materials that occur in the foundations for embankments shall be removed by clearing, stripping and/or grubbing. When required by the County representative, the embankment and the materials used shall be approved by a Geotechnical Engineer. All materials in embankments shall be placed, moistened, and compacted as outlined in the following paragraphs.

When the material needed for embankment exceeds the amount of material available from excavation, sufficient additional materials shall be provided by the Contractor. All materials used for embankment construction shall be free from deleterious materials and rocks larger than three (3) inches in diameter and all other material unsuitable for construction of embankments. Rocks larger than three (3) inches may be used when recommended by the Geotechnical Engineer and approved by the County representative.

Grading of completed embankments shall bring the surfaces to a smooth, uniform condition with final grades being within 0.1 foot of the design grade. Cut and fill slopes shall be a 2 horizontal to 1 vertical maximum (2h: 1v). Construction of slopes steeper than 2h: 1v or fills in excess of five feet, or when placement is on a slope of greater than 5h: 1v shall be reviewed and recommended by the Engineer.

4.3.2.2 COMPACTION OF EARTH MATERIALS. The fill material shall be deposited in horizontal layers having a thickness of not more than eight (8) inches and then compacted to the density as herein specified. Moisture content during compaction operations shall be within two percent (2%) of optimum for granular soils and shall be two to five above (2%-5%) optimum for fine-grained soils unless otherwise directed by the Geotechnical Engineer. The moisture content shall be uniform throughout the layers.

If the moisture content is greater than specified for compaction, the compaction operations shall be delayed until such time as the material has dried to the specified moisture content. When the material has been conditioned as herein specified, the backfill or embankment shall be compacted as directed below.

Under roadways, curb and gutter, sidewalks and driveways, and extending two (2) feet beyond the proposed construction (or to a distance equal to the depth of the embankment material, whichever is greater), the embankment material shall be compacted to a density equal to not less than ninety five (95) percent for granular soils and ninety (90) percent for fine-grained soils. Other fills and embankments not noted above shall be compacted to ninety (90) percent maximum dry density.

Exposed natural soils within construction areas, beneath walkways, slabs and pavement shall be scarified to a depth of twelve (12) inches; moisture conditioned, and compacted to the specified density. Where rock or other acceptable material is exposed, scarification may not be necessary.

Foundations for structures shall be uniform throughout and shall not be placed partially on undisturbed soil or compacted fill and partially on cemented deposits or rock.

Foundation soils should not be allowed to become saturated during construction.

4.3.2.3 SUBGRADE PREPARATION. As a minimum, the original soils under roadways curb and gutter, sidewalks, and driveways shall be scarified to a depth of one (1) foot prior to compaction operations. All scarified soils shall be compacted to the equivalent of ninety five (95) percent of maximum dry density for granular soils or ninety (90) percent of maximum dry density for fine grain soils. Additional overexcavation and recompaction of original soils due to poor subgrade conditions may be required. Subgrades shall be shaped and graded to the design grade. Drainage shall be maintained at all times. Subgrades shall be stabilized and compacted as directed. When springs or underground water is encountered during construction the Engineer and the County's Representative shall be notified immediately. Work shall not proceed until an acceptable mitigation plan is approved. Ground water discovered during construction shall not be ignored.

The subgrade preparation requirements listed above are considered to be the minimum. When required, the subgrade shall be overexcavated and the material removed from the site. Select borrow material may be imported, placed and compacted as directed by the County's Representative.

To demonstrate the stability and compaction of the subgrade, the Contractor may be required to proof-roll the subgrade prior to placing any base gravel.

The subgrade shall be proof-rolled with at least one pass coverage with a roller with pneumatic tires or other acceptable equipment of at least ten (10) ton capacity. All proof-rolling shall be accomplished in the presence of the County's Representative. Ground contact pressure for all tires shall be eighty five to ninety (85-90) psi unless otherwise recommended.

When the proof-rolling shows an area to be unstable, it shall be brought to satisfactory stability by additional compaction, reworking, or removal of unsuitable material and replacement with acceptable material.

4.3.2.4 CONSTRUCTION OF NON-STRUCTURAL FILLS. Fills shall be placed to the lines and grades shown on the approved drawings and shall include all areas not specifically designated for support of structures, roads, utilities, easements, drainage ways, etc. (such as landscape areas, open space areas, etc.). Fill material shall generally be compacted to a minimum of ninety (90) percent of maximum density and shall consist of material that can be compacted to prevent settlement such as soil, rocks, blocks, crushed stone, broken concrete, etc. Fill material shall not include broken asphalt, toxic or hazardous materials waste sludge, deleterious materials such as muck, ash, sod, grass, trash, tree stumps, lumber, dead animals, etc.

4.3.3 QUALITY CONTROL. All earthwork shall be performed in accordance with these standards and shall be tested and accepted as follows:

4.3.3.1 TESTING. Minimum testing of earthwork shall be as follows:

Soil Classification - One per material source. Soil classifications shall be in accordance with AASHTO M-145. For determination of granular soils or fine grained soils use ASTM D-2487 (Unified Soil Classification System). The sieve analysis shall be according to ASTM C-136 and C-117.

Soil Proctor - One determination for each significant change in soil type as necessary to provide required compaction testing. Tests shall be ASTM D-1557 method A or D (modified proctor).

Earth fill moisture/ density determination - One test per five hundred (500) cubic yards of fill placed in an embankment. Tests shall be ASTM D-1556 or D-2922 and D-3017.

Subgrade moisture/ density determination - One test per seven hundred fifty (750) square yards of surface area. Tests shall be ASTM D-1556 or D-2922 and D-3017. Additional moisture density determinations may be made when required by the County's Representative.

4.3.3.2 ACCEPTANCE. Any earthwork determined not to be in compliance with these standards shall be removed and replaced or reworked until compliance is obtained. Costs for the rework or testing the

rework shall be paid for by the Contractor.

4.3.4 SPECIAL REQUIREMENTS. The requirements outlined in this section are only a minimum. When a geotechnical investigation is required, the recommendations of the geotechnical report shall be followed unless said recommendations are less than minimum standards.

All development projects shall submit a final soils engineering and engineering geology report in accordance with the County's applicable Building Code.

4.4 PIPELINE CONSTRUCTION. This subsection covers the requirements for materials, trenching, placing, backfilling, cleaning, testing and other miscellaneous requirements for underground pipeline construction and associated work. This section incorporates the requirements of the AWWA Standards and the Manufacturer's Recommended Installation Procedures, whichever is more stringent.

4.4.1 MATERIALS. This subsection specifies the acceptable materials for pipeline construction for use in sanitary sewers, underground culverts, storm drains, water pipes, and appurtenant construction. All materials shall be new and conform to the requirements for class, brand, size and material as specified herein. All materials shall be stored and handled in accordance with manufacturer's recommendations.

4.4.1.1 SEWER PIPE AND FITTINGS. Only those pipe materials listed below may be used in the construction of sanitary sewer line unless otherwise approved in writing by the County representative.

A. **POLYVINYL CHLORIDE (PVC) PLASTIC SEWER PIPE.** This specification covers rigid polyvinyl chloride (PVC) pipe and fittings. PVC pipe and fittings from four (4) inches to fifteen (15) inches in diameter shall meet or exceed all of the requirements of ASTM D-3034 with a minimum wall thickness to diameter ratio of SDR-35. PVC pipe and fittings from eighteen (18) inches to twenty seven (27) inches in diameter shall meet or exceed the requirements of ASTM F-679.

Each pipe shall be stamped by the manufacturer indicating compliance with the requirements of the appropriate specification. Any pipe not so stamped shall be rejected.

All pipe and fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. All PVC pipe and fittings shall be made from clean, virgin, Type 1, Grade 1, Polyvinyl Chloride conforming to ASTM D-1784.

All pipe joints shall be bell and spigot type with flexible elastomeric seals in accordance with ASTM F-477. Pipe and fittings shall be assembled with a non-toxic lubricant. Pipes of four (4) inch diameter may be the

solvent weld type, in accordance with ASTM F-656 for primer and ASTM D-2564 for glue. Pipe shall have the following minimum SDR-35 dimensions.

TABLE 4.1
SEWER PIPE DIMENSIONS

Nominal Pipe Size (Inches)	Outside Diameter (Inches)	Minimum Wall Thickness (Inches)
4	4.215	0.125
6	6.275	0.180
8	8.400	0.240
10	10.500	0.300
12	12.500	0.360

Spigot ends shall have a fifteen (15) degree tapered end with a memory mark around the diameter of the pipe to indicate proper insertion depth. Fittings shall be of the same material as the pipe, and shall not have a wall thickness less than that of the pipe furnished.

B. **A.B.S. COMPOSITE AND SOLID WALL SEWER PIPE.** This specification covers Acrylonitrile-Butadiene-Styrene (ABS) gravity sewer pipe.

All ABS composite sewer pipe shall conform to the latest revision of ASTM Specification D-2680. The ABS material used shall be a virgin rigid plastic conforming to ASTM Specification D-1788 for rigid ABS plastics. The other component shall be Portland Cement, Perlite concrete or other inert filler material exhibiting the same degree of performance.

All solid wall ABS pipe shall conform to ASTM Specifications D-2751. Solid wall pipe used for laterals shall have a minimum wall thickness to diameter ratio of SDR-35. Fittings not described by these standards shall be shop fabricated or molded from materials listed in paragraphs 4 and 5 of ASTM D-2680 and shall be of equivalent quality to those described.
All field joints shall be chemically welded. Primer, then cement, shall be applied liberally to the outside of the spigot end and the inside of the coupling immediately prior to stabbing the pipe together. The pipe spigot end shall be supplied with home marks to assure proper jointing.

C. **NON-REINFORCED CONCRETE PIPE.** Non-reinforced concrete sewer pipe may be used up to and including twenty-four (24) inch size, unless otherwise designated by the County representative or these specifications. Appropriate design justification shall be submitted by the

Engineer to the County for review and approval prior to use. Pipe shall be extra strength and manufactured to comply with the requirements set forth in ASTM Designation C-14, Class 3 unless otherwise approved by the County representative. Type V cement shall be used unless otherwise approved. Joints shall be of the bell and spigot-type with rubber gasket design, and with joints and gaskets conforming to the requirements of ASTM Designation C-443. Pipe joints shall be so designed to provide for self-centering, and when assembled the gasket shall compress to form a water-tight seal. The gasket shall be confined in a groove on the spigot so that pipe movement or hydrostatic pressure will not displace the gasket.

D. **REINFORCED CONCRETE PIPE.** Reinforced concrete pipe may be used for all appropriate applications. For pipe greater than twenty-four (24) inches in diameter, and where any non-reinforced concrete pipe installation does not provide a cover of at least three (3) feet over the top of the pipe, reinforced concrete pipe shall be used. Reinforced concrete pipe shall comply with the requirements of ASTM C-76 (Class II - V) unless otherwise approved by the County representative. Type V cement shall be used unless otherwise approved. Joints shall be of the bell and spigot design with rubber gasket type joints, with an alternate option of tongue and groove joints for storm drain lines when approved by the County representative.

4.4.1.2 STORM DRAIN PIPE. Pipe listed under Sections 4.4.1.1 A. C. and D. "Sewer Pipes" of these standards, as well as the following pipes, may be used in the construction of storm drain lines and culverts.

A**.** **CORRUGATED POLYETHYLENE PIPE.** Corrugated polyethylene pipe shall be high density polyethylene corrugated exterior with a smooth interior wall. Eight to ten (8-10) inch diameters shall meet the requirements of AASHTO M-252 and have a smooth interior liner. Twelve to thirty six (12-36) inch diameters shall conform to AASHTO M-294 Type S. Forty-two to forty-eight (42-48) inch diameter shall conform to AASHTO MP-6 type. Materials shall conform to ASTM D-3350. All pipe joints and fittings shall be water tight and conform to AASHTO M-353 or M-294, and shall be approved by the County's Representative.

B. **CORRUGATED ALUMINUM PIPE**: Corrugated aluminum alloy pipe shall conform to AASHTO designation M-196. Any aluminum alloy to be in contact with concrete shall first be spray or brush coated to a minimum thickness of 0.05 inch with an asphalt-fiber compound conforming to the requirements of Section 702 of the State of Utah Standard Specifications for Road and Bridge Construction. The aluminum alloy shall be thoroughly cleaned, including the removal of oil and grease, and shall be dry prior to treatment. Pipe installation and appurtenances shall conform to UDOT Standard Specifications.

C. **CORRUGATED STEEL PIPE.** Use of corrugated steel pipe shall require pre-approval from the County Representative and shall be on a case-by-case basis.

Corrugated steel pipe shall be in conformance with AASHTO M-36 and other applicable AASHTO standards as required. Smooth flow spiral rib pipe shall generally be used in storm drain applications while other applications may require annular or helical corrugations. Pipes shall be fabricated with a continuous lock seam or ultra high frequency resistance welded seams.

(1) COATINGS. All pipe shall have an aluminized coating, both sides, in accordance with AASHTO M-274 specifications unless otherwise approved. The pipe shall be fabricated from steel coils that have been hot-dipped coated in a bath of commercially pure aluminum. This coating shall be uniform throughout on both sides of the sheet and be metallurgically bonded between the metals. When a polymer coating is approved for use, such coating shall be a minimum of 10 mils in thickness and shall be a two-sided coating and shall conform to AASHTO M-245. When a galvanized coating is approved for use, such coating shall be hot dipped in accordance with AASHTO M-245. The coating shall be on both sides. Other coatings and linings may be approved.

(2) JOINTS. All joints shall have the same base metal and coating as the pipe being joined. Joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, to prevent separation of the pipe, to prevent infiltration of fill material and to provide water tight joints. O-ring gaskets or other acceptable material shall be used.

(3) FITTINGS AND ACCESSORIES. All fittings, bolts and accessories shall meet applicable specifications of the pipe being used. Use accessories and gaskets recommended by the manufacturer.

(4) INSTALLATION. Installation shall be in accordance with the manufacturer's recommendations and these specifications.

NOTE: Use of this pipe may require significant testing and evaluation to determine compatibility with the ground and the intended installation. Soil Ph, resistibility and other necessary determinations should be made to ensure compatibility.

4.4.1.3 SEWER MANHOLES. This subsection covers the requirements for the materials used in sanitary sewer and storm water manholes. Manholes shall be water tight and be furnished complete with cast iron rings and covers as follows:

A. **CONCRETE BASES.** Manhole bases shall be either pre-cast or cast in place. Precast manhole bases shall conform to ASTM C-478. Concrete for cast in place bases shall be in accordance with Section 4.8.1 of these specifications. Type V cement shall be used for precast and cast in place bases.

Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross-section. Changes of direction of flow within the manholes shall be made with a smooth curve with the longest radius possible. The depth of the channel in the manhole base shall be the full diameter of the sewer pipe being used at that manhole. The floor of the manhole outside the flow channels shall be smooth and slope toward the channel in accordance with standard drawings and not less than one-half (1/2) inch per foot nor more than one (1) inch per foot.

B. **WALL AND CONE SECTIONS.** All manholes shall be constructed of either forty eight (48) inch or sixty (60) inch inside diameter pre-cast, sectional, reinforced concrete manholes. Both cylindrical and taper sections shall conform to the requirements of ASTM Designation C-478 for precast Reinforced Concrete Manhole Sections. All Manholes shall have ladders in accordance with the standard drawings.

Throat length of manholes shall be adjustable by use of appropriate diameter grade ring sections. The maximum height shall be eighteen (18) inches.

The taper section shall be a maximum of three (3) feet in height, shall be of eccentric conical design, and shall taper uniformly from forty eight (48) or sixty (60) inches to thirty (30) inches inside diameter. The cone shall be set on the manhole sections so all ladder rungs are aligned.

When manhole depths are less than four (4) feet manhole cones shall not be used. The manhole shall consist of a cylindrical manhole section with a precast flat manhole top in accordance with ASTM C-478.

Sixty (60) inch inside diameter sewer manholes shall be required for all sewers greater than twelve (12) inches in diameter or deeper than twelve (12) feet, or where three (3) or more eight (8) inch or greater lines converge in the manhole.

The shaft section of the manhole shall be furnished in section lengths of one (1), two (2), three (3), and four (4) feet as required. The least number of sections should be used.

Manholes larger than sixty (60) inch inside diameter may be required when designated by the County representative.

All joint surfaces of pre-cast sections and the face of the manhole base shall be thoroughly cleaned prior to setting the sections. Joints shall be sealed with a minimum one (1) inch thick flexible joint sealant which shall conform to the requirements of ASTM C-923.

C. **WATER-TIGHTNESS.** All manholes shall be water tight. Any cracks or imperfections shall be satisfactorily repaired. Materials and methods used shall be subject to approval of the County's Representative.

D. **IRON CASTINGS.** All iron castings shall conform to the requirements of ASTM A-48 (Class 30) for grey iron castings. Frames and covers shall have a minimum combined weight of four hundred (400) pounds. All castings shall be designed to carry a minimum HS-20 traffic loading.

The cover and ring seat shall be machined so that the entire area of the seat will be in contact with the cover, in any position of the cover on the seat. Frames and covers shall be so constructed and machined that the parts are interchangeable. The tops of the cover and frames shall be flush, and the clearance between the frame and cover shall be one-eighth (1/8) of an inch all around. The top surface of each cover shall be cast with a studded pattern including the word "Sewer" for sanitary application and "Storm" for storm drain applications. Letters and studs shall be raised three-eighth (3/8) inch. Each cover shall be provided with not less than twelve (12) ventilating holes of three quarter (3/4) inch diameter each.

All manhole frames shall be carefully set to the finished grade or as directed by the County's Representative. When set in roadways, walkways or other travelways, the finished manhole cover, grade, and slope shall be adjusted to match that of the traveled surface. Manhole frames shall be set in place on the manhole throat and shall be sealed with an approved flexible joint sealant which shall conform to the requirements of ASTM C-923. Frames or covers loosened from the manhole throat shall be reset and any frames, covers or throat sections damaged or broken shall be replaced prior to acceptance by the County's Representative.

E. **MANHOLE STEPS.** Manhole steps shall be constructed in accordance with ASTM C-478 and the standard drawings.

Manhole steps shall be installed at intervals no closer than twelve (12) inches and at evenly spaced intervals not to exceed eighteen (18) inches between steps. Steps shall be firmly installed into the concrete wall and taper sections of all manholes to a minimum depth of three and three-

eighth (3 3/8) inches, as shown in the drawings. Each step shall be solidly anchored to the wall so it will not pull out or break under repeated use. Steps shall be aligned vertically to form a continuous ladder from top to bottom.

4.4.1.4 WATER PIPE AND FITTINGS. The materials used for pipe and fittings shall all be new and conform to the requirements for class, brand, size and material as specified.

A copy of the manufacturer's installation recommendation for each type of pipe shall be provided for each construction job and shall be available on the jobsite at all times. These recommendations shall be followed during construction unless instructed otherwise by the County's Representative. All pipe materials are as outlined below.

A. **GENERAL PIPE REQUIREMENTS.** Pipe materials shall conform to the following requirements.

TABLE 4.2
GENERAL PIPE REQUIREMENTS

SIZE	TYPE
3/4"	Black or Blue Poly (HDPE) Iron Pipe Size
1" - 2"	Schedule 80 PVC or Black or Blue Poly (HDPE) Iron Pipe Size
Over 2"	Ductile Iron Class 51 with poly jacket sock or PVC C-900, Class 150 (sand bedded) see note #1 below. Black or Blue Poly (HDPE)

Notes:
1. Copper (Type K) pipe up to two 2 inches in diameter may be used upon approval of the applicable water company.

2. For pipes greater than 12 inches, material type will be determined by the applicable water company.

3. When the pipe is to be installed in a rocky area, the pipe material should be ductile iron.

4. All piping used for the purpose of irrigation only shall be purple in color.

All pipe shall conform to the current AWWA standards for each class of pipe listed above.

B. **CONNECTING WATER METERS**. Only authorized employees of the applicable water company shall be allowed to connect or disconnect water meters. All boxes set in concrete shall be flanged to prevent settlement.

C. **DUCTILE IRON PIPE.** All ductile iron pipe shall be Class 51 conforming to the latest edition of AWWA Specifications C-151 (ANSI A21.51).

C.1 **JOINTS.** Ductile Iron Pipe shall be either Mechanical Joints, Rubber Gasket Slip-on Joints, Flanged Joints, or a combination of the above as specified on the plans. Pipe shall also conform to all current AWWA standards.

C.2 **POLYETHYLENE WRAPPING.** A polyethylene wrap shall be required on all ductile iron pipe. The polyethylene wrap tubing shall be cut to provide for a minimum of one foot of lap over both the adjoining pipes. The ends of the tubing shall be wrapped using three circumferential turns of plastic adhesive tape. The loose wrap on the barrel shall be pulled snugly around the barrel of the pipe and the excess folded over at the top. This fold shall be held in place by means of six inch long strips of plastic tape placed at intervals of three feet along the pipe barrel.

Bends, reducers, offsets and restraint gland locations shall be wrapped in the same manner as the pipe. Valves shall be wrapped by bringing the tube wrap on the adjacent pipe over the bells of the valve and sealing with adhesive tape. The valve bodies shall then be wrapped with flat sheets passed under the valve bottom and brought up around the body to the stem and fastened with the tape.

E. **PVC OR HDPE PIPE**. All PVC Pipe used shall meet the latest AWWA standards C-900. HDPE pipe shall meet the latest AWWA standards C-901 and C-906.

F. **COPPER PIPE.** Where service lines are two (2) inch or less in diameter, type K copper pipe may be allowed with prior approval of the applicable water company. Pipe which has outside dimensions greater than two (2) inches in diameter shall not be copper. All copper pipe shall conform to the current AWWA standards.

G. **PIPE FITTINGS**. (Two inches through 30 inches) flanged and

mechanical joint fittings shall be ductile iron class 250, and shall be produced in accordance with ANSI/AWWA C-110/A 21.10 and ANSI/AWWA C-111/A21.11 and shall conform to details and dimensions published therein. Fittings are cement lined and seal coated in accordance with ANSI/AWWA C-104/A21.04.

For large tappings (over 2") tapped into PVC or ductile iron pipe, the following tapping sleeves are recommended subject to the approval of the applicable water company for pressures less than 125 psi:

Romac Style fts 419, fts 420
Power Seal (5 bolt), model 3480
Romac 305 Stainless Steel Service Saddle

For pressures greater than 125 psi, a mechanical joint sleeve type will be required. The following are recommended subject to the approval of the applicable water company for use.

Mueller H-615
5-149-DI
Clow F-5205
Power Seal Model 3490
Romac SST-III with ductile flange rated at 200 psi
Ford FTSS

For larger diameter pipe:

FTS-425 Class D
For HDPE - Romac SST-H

H. **TAPPING MATERIAL SPECIFICATION.** For small tappings (three quarter (3/4) inch through two (2) inch) tapped into cast iron, steel, PVC, or ductile iron pipe, the following materials shall be required:

H.1 **SADDLE CASTINGS.** Large saddle tappings shall be stainless steel or bronze single/double strap.

H.2 **STAINLESS STEEL STRAP.** The stainless steel strap shall consist of a two (2) inch wide strap and shall come complete with sufficient stainless steel or bronze bolts, nuts and washers (with five-eighths [5/8] inch N.C. Teflon coated roll threads) to properly clamp the strap to the pipe. M.I.G. welds shall be passivated for resistance to corrosion. All tapping saddles shall have a polyethylene wrapping.

H.3 **GASKETS.** Gaskets shall be made from virgin SBR compounded for water services.

I. **REPAIR CLAMPS**. All repair clamps shall be stainless steel and be equal to the following approved brands subject to the approval of the applicable water company:

Romac SS1-552
Power Seal 3121AS, 3122 AS

For HDPE

Romac Style SS1-H, SS2-H

J. **VALVES AND BOXES.** Unless otherwise specified by the applicable water company, all valves, twelve (12) inches and smaller, should be of a resilient-seat-gate-valve type, and all valves over twelve (12) inches should be butterfly valves.

J.1 **GATE AND BUTTERFLY VALVES.** Valves shall conform to the latest revision of AWWA valve standards.

All valves installed next to a fitting must be flange x mechanical joint (MJ) and installed with the flange end connecting to the tee, cross, or fitting and megalugged to the line unless otherwise approved by the applicable water company.

All six and eight inch valves shall have a 16"x 16"x 4" slab of concrete placed under them for support. Valves ten inches and greater shall have a 20"x 20"x 4" concrete slab placed under them for support. All support slabs shall be tied to the valves.

J.2 **VALVE BOXES.** All valves shall be provided with a cast iron valve box of the extension sleeve type or a screw type adjustable, and the height shall be adjusted to bring the top of the valve box flush with the finished surface. Extension sleeve shall be drilled or slotted and the marking wire shall be threaded through. The valve box shall not be less than five (5) inches in diameter and shall have a minimum wall thickness of .375 inch. The box shall be provided with a suitable base and cover. The word "WATER" shall be cast on the cover. Valve boxes intended for irrigation main line valves shall be triangle in shape and the word “IRRIGATION” shall be cast on the cover.

Valve boxes shall be installed plumb and properly positioned to allow access of the operating wrench. To ensure that the box is not displaced during backfill operations, the backfill shall be hand mechanically tamped for a distance of five (5) feet each way along the trench. All valve boxes shall include a concrete collar in accordance with the standard drawings with flow indication arrows.

K. **WATER SERVICE LATERALS.** All water service laterals shall include yoke, box and lid. The material used for water service connections shall comply with the following requirements.

K.1 **SERVICE PIPE.** Service pipe shall be polyethylene or copper type K as applicable.

Note: When polyethylene pipe is used, ***no*** *Instatite* fittings shall be used. If a service lateral becomes damaged during construction or needs to be extended, a new lateral must be installed from the main line to the meter setter. No joints will be allowed.

K.2 **CORPORATION STOPS.** Corporation stops shall be as manufactured by the Mueller Company, or Ford or approval equal, and shall conform to the several designations shown below for the various sizes.

TABLE 4.3
CORPORATION STOPS

	WATER SERVICE CONNECTION SIZE			
	3/4"	**1"**	**1-1/2"**	**2"**
MUELLER CO.	H-1500	H-1500	H-1510	H-1501
FORD	F600	F600	F6125	F6125

All services shall be a compression type joint for the service pipe and shall be threaded on the inlet end with an AWWA corporation stop thread.

K.3 **METER SETTER YOKES.** Meter setters or meter yokes shall have a built-in backflow prevention device and shall have a corrosion-resistant bronze body, dual acetyl plastic valves with natural rubber gaskets that are independently acting and capable of giving two levels of protection; stainless steel springs; a resilient O-ring end-tap seal; and full port inlet angle ball valve with brass handle. All internal parts shall be accessible without removing the valve from the line. Meters shall be installed by water company personnel only.

K.4 **METER BOX AND LID.** The meter boxes shall be high density polyethylene (HDPE) cast iron, or as approved by the applicable water company. Irrigation meter boxes shall be purple in color.

The meter box lids should have a hinged opening for meter reading. Lid marking shall be approved by the water company. A concrete collar shall be installed around the meter box in accordance with standard drawings.

All meter boxes shall be placed behind sidewalks in accordance with standard drawings unless otherwise directed by County's Representative.

Any meter box covered, or damaged, during construction operations shall be uncovered, replaced, and raised to finish grade by the Contractor. In areas without sidewalks, meter boxes should be flush, or one inch above the finish grade.

K.5 **SERVICE CONNECTIONS.** At all points designated by the water company, service connections shall be installed and shall extend from the property line to the building, unless otherwise directed by the water company.

Individual water services shall be three quarter (3/4) inch single service from the water main to the meter setter for normal domestic service. When directed by the water company, the water service shall be larger in diameter. Services shall have a minimum of three (3) feet of cover to subgrade and be constructed as shown in the standard drawings. For service laterals two inches in diameter and smaller, service saddles shall not be closer than twelve (12) inches from the end of the main, nor closer than eighteen (18) inches to any other service saddle or pipe joint.

A mechanical joint type tapping sleeve shall be used on all "hot taps". The type of mechanical joint sleeve shall be approved by the water company and the County Representative.

L. **MARKING WIRE.** Marking wire shall be installed on all waterline installations unless otherwise approved by the County Representative. Marking wire shall be 12 gauge solid copper with PVC or PE insulation and conform to the following:

L.1 Marking wire shall be spliced together with "grease" nuts, or equal. Prior to installation of the wire nut, a minimum amount of wire shall be bared and twisted together with pliers to assure good contact.

L.2 Marking wire shall be taped and pulled tight along the top of the pipe to ensure against breakage.

L.3 Marking wire shall extend up to all hydrants, valves and meter

boxes following service lines into meter box. At valve clusters marking wire shall be run to all valves. The marking wire shall be installed to the valve to correspond to the water line that is shut off by that valve. The wire shall be pig tailed, not looped.

L.4 Marking wire shall extend out of the valve box a minimum of twelve (12) inches.

L.5 It is the Contractor's responsibility to guarantee and show that the marking wire performs satisfactorily for its intended use. It is required that the contractor test the performance of the wire prior to installation of surface improvements.

L.6 After all the boxes are raised, the Contractor shall notify the applicable water company to perform the final acceptance testing.

M. **FIRE HYDRANTS.** Fire hydrants shall be a three-nozzle, five and one-half inch (5 ½") diameter Mueller, Modern Centurion, Model A-423; Kennedy, Model K-81A; or approved equal, with foot valve and six (6) inch mechanical joint connection. Fire hydrants shall conform to the latest edition of AWWA C-502, "Dry Barrel Fire Hydrants." All hydrants shall be designed for a working pressure of two hundred (200) psi and a hydrostatic pressure of three hundred fifty (350) psi. Hydrants shall be furnished with a paint finish above the ground line identical in color to the existing hydrant paint (red).

Hydrants shall be installed with a shut-off valve at the mainline. If the hydrant lateral is greater than two hundred (200) feet long, a second valve shall be installed at a location determined by the County Representative.

After the hydrant is installed and accepted, it will be the responsibility of the applicable water company to maintain the hydrant. Where applicable, the customer/property owner will allow the water company access for said maintenance.

Dead-end mains shall not be installed without prior approval of the County Representative. If installed they shall not exceed six hundred (600) feet in length. Hydrants shall be located at the end of dead-end mains for flushing purposes as well as for fire protection. Washout valves, in lieu of fire hydrants, are not allowed without prior approval of the County Representative.

Hydrants shall be of a flanged joint type or mechanical joint inlet. All hydrants shall be so designed as to allow the flanges at sidewalk level to separate without material damage to the main barrel section when struck by a large object, such as a vehicle. Upon such damage, the main gate

valve must remain closed to avoid flooding or washout. Hydrants with a nominal five inch valve opening shall be furnished with two nominal two and one half (2 ½") inch National Standard Thread Hose Nozzles and one nominal five (5") inch National Standard Thread Pumper Nozzle. All nozzles shall be furnished with a cap and gasket with attaching chain. All hydrants shall open counter clockwise with a pentagon operating nut conforming in size to the specifications of the applicable water company.

Fire hydrants shall be set to provide at least the minimum pipe cover for the branch supply line. Nozzles shall be at least eighteen (18) inches above finish grade. Each hydrant shall be set on a concrete foundation at least eighteen (18) inches square and four (4) inches thick. Each hydrant shall be adequately thrust-blocked against the end of the trench. Hydrant drainage shall be provided by installing gravel or crushed rock (3/4" to 2" washed gravel) around the hydrant, and below the top of the hydrant supply line. One third (1/3) cubic yard of one and one half (1 ½") inch gravel shall be placed around the drain holes just above the hydrant valve casing. All hydrants shall stand plumb. The hydrant pumper nozzles shall face the street and be perpendicular to the curb line. The hose nozzle shall be parallel to the street. Hydrants shall be located inside the public utility easements or as otherwise directed by the County Representative. A concrete pad should be installed around the hydrant in accordance with the standard drawings.

N. **PRESSURE REDUCING VALVES**. Pressure reducing valve installation should be constructed as per the detail shown in the standard drawings. The valves will be as manufactured by Singer, CLA-val or equal and approved by the County Representative.

O. **MEGALUG SYSTEM.** A megalug retainer gland system shall be used on all mechanical joints and shall meet UNI-B-13 for PVC and be UL/FM approved through twelve (12) inch diameter for both ductile iron and PVC pipe. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A536. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used (through fourteen inches) with a minimum safety factor of 2:1. Gland shall be Megalug by EBAA Iron, Inc. or approved equal. The type and model of retainer and amount for each connector is shown on standard drawings.

As an alternate to the megalug system, Ford Uniflange Series 1400 retainer glands and Series 1300 and 1390 joint restraints will be used. For PVC, Ford Uniflange Service 1500 retainer gland will be used. All other materials shall require prior approval by the applicable water

company and the County Representative.

4.4.2 CONSTRUCTION METHODS. This subsection covers the requirements for trenching, placing, and back filling of all underground pipelines (sewer, water, storm drains, etc.). The methods employed in performing the work shall be the responsibility of the Contractor. The Contractor shall make such changes in the methods used as are necessary to install an acceptable finished product. The methods shall include, but are not limited to the following:

4.4.2.1 CONTROL OF GROUND WATER. All trenches shall be kept free from water during excavation, fine grading, pipe laying, jointing, and embedding operations. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water, and in cases where the static ground water elevation is above the bottom of any trench or bell hole excavation, such ground water shall be lowered and controlled to the extent necessary to keep the trench free from water and the trench bottom stable when the work within the trench is in progress. Surface water shall be prevented from entering the trenches.

Dewatering for pipeline construction shall commence when groundwater is first encountered and shall continue until such time as water can be allowed to rise. Requirements of section 4.3.2.2 shall be complied with when groundwater is encountered. Dewatering shall be conducted such than no pipelines are placed in water nor shall water be allowed to rise over the pipe until the pipeline has been pressure tested and any concrete or mortar has achieved final set. Water shall not be allowed to rise in pipeline trenches or drained excavations until pipelines are backfilled or restrained to prevent flotation.

4.4.2.2 EXCAVATION FOR PIPELINES. Trench excavation shall include all operations necessary for excavation of all materials of whatever nature in relation to pipeline installation. All excavation, including the manner of support and provisions for access to trenches, shall comply with all current regulations as determined by OSHA. Trenches shall be excavated to the lines and grade shown on the drawings, and to a depth to provide the minimum required cover over the pipe unless otherwise approved by the County Representative. Pipe installation shall be in accordance with the pipe manufacturer's recommendations. The bottom two (2) feet of the trench should have vertical walls. All finish grading necessary for preparation of the trench bottom shall be made manually. Over-excavating shall not be allowed without re-compaction of backfill in accordance with these standards.

Excavation for trenches in rock shall extend to a depth of at least four (4) inches below the bottom of the pipe. Bedding material as outlined in Table 4.1 shall be placed and mechanically compacted to ninety five (95) percent of maximum dry density in maximum six (6) inch lifts to provide a smooth,

well compacted and stable foundation for the pipe or appurtenant works.

Trench bottoms shall be hand-shaped as specified and the maximum width of the trench, measured at the top of the pipe, shall be as narrow as possible, but not wider than fifteen (15) inches on each side of the pipe.

Where unstable earth, mud or muck is encountered in the excavation at the grade of the pipe, the unsuitable material shall be removed to a minimum of twelve (12) inches below grade and the subsequent hole shall be backfilled with crushed rock or gravel (as called out in Table 4.1 under "foundation material") to provide a stable subgrade. The gravel material shall be deposited over the entire trench width. The maximum layer thickness shall be six (6) inches. Each layer shall be compacted by tamping, rolling, vibrating, spading, slicing, rodding or by a combination of one or more of these methods. In addition, the material shall be graded to produce a uniform and continuous support for the entire length of the installed pipe.

Should the Contractor elect to install the pipe by boring, or jacking, approval must first be obtained from the County's Representative. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavation, and all pumping, ditching, or other approved measures for the removal or exclusion of water, including, but not limited to, storm water and waste water reaching the worksite from any source so as to prevent damage to the work or adjoining property.

The maximum amount of open trench permitted in any one location shall be two hundred (200) feet, or the length necessary to accommodate the amount of pipe installed in a single day, unless otherwise approved by the County's Representative. Open trenches shall not be allowed to stay open without proper safety precautions and barricading. Trenches should not be left open over night.

In the event "foundation material" is used in backfill, or replacement of over excavated material, the Contractor should, construct dams within the drain rock bedding material at maximum intervals of six hundred (600) feet. The dams shall be constructed to the top of the pipe or the level of groundwater, whichever is greater, with Class "B" Portland Cement Concrete or other approved material and shall have a minimum thickness of six inches.

TABLE 4.5 BACKFILL MATERIAL				
SIEVE SIZE	FOUNDATION MATERIAL	BEDDING/PIPE ZONE MATERIAL*	12" ABOVE PIPE ZONE	FINAL BACKFILL MATERIAL
	PERCENTAGE PASSING			
	- -	- -		Native material which contains no sod, vegetation, rocks larger than 3" diameter, asphalt or concrete chunks, etc.
	- -	- -		
3"	100	- -	100	
2"	90 - 100	- -	70 - 100	
1"	70 - 90	100	50 - 100	
1/2"	51 - 75	80 - 100	30 - 100	
#4	31 - 65	35 - 90	25 - 80	
#16	16 - 40	20 - 45	16 - 50	
#200	2 - 12	2 - 15	2 - 20	

* 3/4" or 1" clean crushed gravel may be used in lieu of the above table.

4.4.2.3 SHEETING, BRACING, AND SHORING OF EXCAVATIONS. All excavations shall be sheeted, braced, and shored as required to protect the workers and existing utilities and improvements from sliding, sloughing, settling or other movement of the trench walls while the work is in progress. All such sheeting, bracing and shoring shall comply with the requirements of the Utah State Industrial Commission. All damage resulting from lack of adequate sheeting, bracing and shoring shall be the sole responsibility of the Contractor, and the Contractor shall affect all necessary repairs or reconstruction resulting from such damage.

4.4.2.4 BLASTING. The Contractor shall comply with all laws, ordinances, and applicable safety code requirements and regulations relative to the handling, storage, and use of explosives and protection of life and property.

All requirements contained in Section 2.9, Use of Explosives, shall be followed.

4.4.2.5 PIPE LAYING AND BEDDING. Pipe will be carefully inspected in the field by the Contractor and the County's Representative before and after laying. If any cause for rejection is discovered in a pipe before or after it has been laid, it shall be removed and replaced by the Contractor.

When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose the existing improvement before laying any pipe or conduit. The County's Representative shall be given the opportunity to inspect the existing pipe or conduit before the connection is made. Adjustments in line or grade of the connecting pipe which may be necessary to accomplish the intent of the plans will be made at this time.

Pipe shall be laid up grade with the socket bell, or collar ends of the pipe up grade unless otherwise authorized by the County's Representative. In general, the pipe will be laid in one direction only.

Pipe shall be laid true to line and grade, with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the bell or collar, which shall not bear upon the subgrade or bedding. Any pipe which is not true to alignment or shows any settlement after laying, shall be removed and re-laid to the proper grade and alignment.

A. REQUIREMENTS FOR LINE AND GRADE. All sewer and drainage pipe shall be installed to the defined line and grade within the following limits.

A.1 Variance from established grade shall be not greater than one - tenth (1/10) of a foot between manholes. Variance from established line shall be not more than one half foot between manholes. Any variances approved shall not impact the system design capacity and shall be approved by the County's Representative. Any variations shall not result in a level or reverse slope installation.

A.2 The invert elevations of each manhole and box at the inlet and outlet and distance between manholes and/or boxes shall be accurately verified by use of surveying instruments prior to pouring the floor or placing prefabricated manholes or boxes.

A.3 On main lines, invert elevations of each manhole inlet and outlet and the distance measurements between manholes shall be verified by use of surveying instruments or laser prior to installing precast manhole bases. For service laterals, grades may be verified by use of a carpenter's level or surveying instrument.

A.4 All sewer and drainage pipe systems shall be visually inspected for defects, displacement, proper workmanship, alignment and general compliance.

B. **INSTALLATION OF PIPE.** A groove shall be excavated along the bottom of the trench to receive the pipe. Bell holes shall be excavated so that only the barrel of the pipe receives bearing from the trench

bottom. Large rocks (over three (3) inches in least dimension) near the trench bottom shall be removed and the hole refilled with approved backfill in accordance with Table 4.5.

Water pipe shall not be deflected at the joint more than a maximum of three degrees, per joint, or as per the manufacturer's recommendation, whichever is more restrictive.

Sewer and drain pipe shall be laid up grade. All pipe installation shall proceed with joints closely and accurately fitted. Gaskets shall be fitted properly in place and care shall be taken in joining the pipes to avoid twisting the gaskets. Joints shall be clean and dry and a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint surfaces to facilitate easy and positive joint closures. If adjustments to the position of a pipe length are required after being laid, the pipe shall be removed and rejoined as a new pipe. When pipe laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material. In addition to the above requirements, all pipe installation shall comply with the specific requirements of the pipe manufacturer.

C. **SETTING OF BENDS, TEES, CROSSES AND REDUCERS.** Bends, tees, crosses, and reducers shall be lowered into the trench, inspected, cleaned and joined to the pipe.

Restraining joints (megalug or equal) shall be used as per the standard drawings. Concrete thrust blocks may not be used as a restraining system for waterline mains or laterals without prior approval of the County Representative and water company. Reaction restraints or, when permitted by the County's Representative, thrust blocking, shall be applied at all bends and tees, and at points of reduction or at fittings where changes in pipe diameter occur.

The design of concrete thrust blocking shall be as shown in the standard drawings or as directed by the County Representative. The material used for thrust blocking shall be Class C concrete. Blocking shall be placed between solid undisturbed ground and the fitting to be anchored. The area of bearing shall in each instance be that required in the standard drawings or by the County's Representative. Unless otherwise directed by the County's Representative, the blocking shall be placed so that the pipe and fitting joints will be easily accessible for repair.

If a megalug retainer system cannot be used, a concrete thrust block system can be substituted, if approved by the County Representative, on a case by case basis.

D. **PLUGGING OF DEAD-ENDS.** Standard plugs shall be inserted into

the bells of all dead-end fittings. Spigot ends of fittings and plain ends of pipe shall be capped. When directed by the County's Representative, a concrete reaction or thrust block shall be provided at all plugged outlet fittings in the sizes indicated on the standard drawings or as directed by the County's Representative. The plugs and caps shall also be tied to the pipe with restraining joints. The number and size of rods shall be as specified.

E. **SERVICE LINES.** All service lines shall be installed in accordance with the details shown on the standard drawings.

F. **PIPE TO BE KEPT CLEAN.** All dirt and foreign matter shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean by means approved by the County's Representative during and after laying.

G. **JOINTING PIPE SECTIONS.** The sealing surface of the pipe, the bell to be joined, and the elastomeric gaskets shall be cleaned immediately prior to assembly, and assembly shall be made as recommended by the manufacturer. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line. Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench or weather conditions are unsuitable for proper installations as determined by the County's Representative.

H. **CUTTING PIPE.** The pipe shall be cut in a neat manner without damage so as to produce a smooth end at right angles to the axis of the pipe. Existing transite AC pipe shall not be cut and should be removed and replaced by authorized trained personnel.

I. **END PREPARATION.** Pipe ends shall be cut square, deburred and beveled in accordance with the pipe manufacturer's recommendations.

J. **PUSH-ON JOINTS.** The push-on joint shall be a single elastomeric gasketed joint which shall be assembled by positioning the elastomeric gasket in the annular groove of the bell and inserting the spigot end of the pipe into the bell. The spigot end of the pipe shall compress the gasket radially to form a positive seal. The gasket and annular groove shall be designed, sized and shaped so that the gasket will resist displacement. Care shall be taken so that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell must be in accordance with the manufacturer's recommendations.

K. **MECHANICAL JOINTS.** The mechanical joint shall be a bolted joint of the stuffing box type, and installation recommendations from the manufacturer shall be followed. Each joint shall consist of:

K.1 A bell provided with an exterior gland having bolt holes or slots and a socket with an annular recess for the sealing gasket and the spigot end of the pipe. On all slotted holes the bolts will be supplied with square shoulders.

K.2 A sealing gasket.

K.3 A follower gland with bolt holes matching those in the fitting.

K.4 Tee bolts and hexagonal nuts of cor-ten metal.

L. **PIPE BEDDING.** Pipe shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded in accordance with the bedding details in the standard drawings.

Pipe bedding materials shall be deposited and compacted in layers not to exceed six (6) inches in compacted thickness. Deposition and compaction of bedding materials shall be completed simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or mechanical compactors to the satisfaction of the County's Representative. All bedding materials shall be placed in the trench with hand tools, or other approved methods in such a manner that the bedding materials will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall conform to the requirements of Table 4.5 of these standards and shall be free from roots, sod, vegetation or other deleterious material.

In the event trench materials are not satisfactory for pipe bedding, imported bedding will be required. Imported bedding material shall be graded in accordance with Table 4.5, under "bedding material".

M. **METER BOXES.** All meter boxes shall generally be located behind the sidewalk. All meters will be provided with concrete collars. Any meter box damaged or covered during the construction operations shall be replaced and/or uncovered and raised to finish grade by the Contractor as determined by the County Representative.

4.4.2.6 BACKFILLING AND COMPACTION. Backfill shall include filling of all trenches to the original ground surface or final grading elevation as shown on the drawings, or otherwise directed by the County's Representative. Backfill shall be carefully placed around and over pipes and

shall not be permitted to fall directly on a pipe from such a height, or in such a manner as to cause damage. Backfill material shall be as required by Table 4.5 or as approved by the County's Representative and shall not contain any wood, grass, roots, broken concrete, frozen soil, asphalt chunks, trash or debris of any kind that may cause unequal settlement or improper consolidation.

The backfill in all utility trenches under proposed or existing roadways, curb and gutter, sidewalks and driveways shall be compacted to the equivalent of ninety five (95) percent of maximum dry density for granular soils or ninety (90) percent of maximum dry density for silty/clay soils.

A. **INITIAL BACKFILL PROCEDURE.** (Pipe Zone) Backfill of selected material, which shall conform to the requirements of Table 4.5, shall be placed carefully in eight inch non-compacted horizontal layers and compacted to a depth of twelve inches over the top of the pipe. During compaction of the initial backfill, special care shall be taken so as to not move the pipe, either vertically or horizontally. All backfill operations shall be performed in such a manner so as to avoid any damage to the pipe, valves, laterals, etc. In the event such damage or displacement occurs, such damaged or displaced pipe shall be removed and replaced with undamaged pipe on proper grade and alignment.

B. **FINAL BACKFILL PROCEDURE.** The backfill above a point twelve (12) inches above the top of the pipe shall be filled in horizontal layers six (6) inches thick or less with materials free from roots, vegetation or other deleterious material, or rocks, stones or boulders larger than three (3) inches in the greatest dimension.

C. **MECHANICAL COMPACTION OF BACKFILL.** The backfill shall be thoroughly compacted by mechanical compaction.

Structural and trench backfill shall be deposited in horizontal layers and compacted by the following method in such manner that the compacted material will be homogeneous and free from lenses, pockets, streaks, and other imperfections.

The materials shall be deposited in horizontal layers across the length or width of the excavation of not more than six (6) inches compacted thickness. The excavation and placing operations shall be such that the materials when compacted will be blended sufficiently to secure the best degree of compaction, impermeability and stability.

Prior to and during compaction operations, all backfill material shall have the required moisture content and shall be uniform throughout each layer.

If the moisture content is not optimum for compaction, the compaction operations shall be delayed until such time that the material has been brought to the required moisture content. When the material has been properly conditioned, it shall be compacted by using appropriate mechanical compaction equipment as indicated below or as otherwise approved by the County's Representative.

C.1 Vibrating rollers shall consist of a self-propelled roller with a vibrating steel drum of at least one (1) ton capacity. The roller shall have an effective rolling width of at least twenty four (24) inches and shall deliver a compaction force of at least seven hundred (700) pounds per square inch when vibrating.

C.2 Pneumatic rollers shall consist of a self-propelled roller with pneumatic tires arranged in a manner so as to provide a satisfactory compacting unit. The roller shall have an effective rolling width of at least thirty (30) inches and shall give a compaction force of at least five hundred (500) pounds per inch of width of tread when fully loaded. The tires shall be uniformly inflated.

C.3 Vibrating plates shall consist of a pneumatic vibrating plate attached to the boom of a backhoe and capable of compacting an area of at least three square feet. The plate and backhoe combination shall together be capable of exerting a compactive force of at least one thousand (1,000) pounds per square inch.

C.4 Hand compactors shall be used when hand-compacted methods are specified or required because the location of the area to be compacted does not permit the use of self-propelled mechanical compactors. Vibrating plates, "pogo-stick" tampers or other approved hand-compacting equipment shall be used.

C.5 Jetting and flooding or other water consolidation methods are not permitted.

4.4.2.7 TRENCHES ON HIGHWAYS AND STREETS. No work of any kind shall be performed in any public right-of-way without first obtaining an encroachment permit and any other required permits. Wherever any trenches will be in, or must cross any State road or any County road, alley or drainage way, the Contractor, or other responsible party, shall obtain any and all excavation and encroachment permits as are required for these crossings and shall become familiar with and abide by the rules and regulations of the Utah Department of Transportation and Washington County.

All Contractors or responsible parties excavating or encroaching over or

under any public right-of-way including roads, drainage way, easements or other public property shall first obtain a permit in compliance with the applicable local ordinances prior to excavating.

All asphalt cuts shall be made with a diamond or carbide-tipped masonry or asphalt cutting saw unless otherwise approved by the County's representative. No scarifier-tooth cuts, back-hoe or bucket rips will be allowed.

All backfilled trenches in roadways shall be patched with hot-mix asphalt within five days of initial excavation, unless otherwise directed by the County's Representative. All backfill shall be in accordance with these standards.

All concrete or asphalt surfaces damaged or cut in trenching operations or other work within the right-of-way shall be restored to an "as-good or better condition" in accordance with the provisions outlined in these standards.

During the entire trenching, backfilling and patching operations, the Contractor shall be required to observe all safety and traffic control procedures as outlined in these standards.

The Contractor shall be responsible for maintenance of the trench, patch, and related work for a minimum period of twelve (12) months from date of completion.

No more than two hundred (200) feet of trench shall be left unfilled at any time in one continuous run, unless otherwise approved by the County's Representative.

All streets and roads shall be kept free from dust and shall be open to through traffic. Approval to close the street must be obtained by the Contractor from the County representative or his designated representative. At least one-half (1/2) the width of any street or road shall be temporarily restored for use before excavation is commenced on the remaining portion of the street or road.

All excavation, backfilling and temporary resurfacing on any portion of any street or road shall be completed in one working day so that trenches are not left open or uncovered over night.

All requirements governing work within a right-of-way as contained in Section 2.5 (Barricades and Warning Signs - Work Area Protection) of these standards shall be adhered to.

All utility installations, i.e., gas, power, phone, cable T.V. and associated utilities, shall conform to the applicable test requirements contained within

these standards for earthwork, compaction, base course, bituminous surface course, concrete and other materials.

4.4.2.8 CLEANING OF SANITARY SEWER LINES. When sewer lines have been placed and the trench backfilled, the sewer lines shall be thoroughly cleaned, flushed, and tested prior to acceptance by the County's Representative. No debris shall be permitted to enter any sewer lines in service. All debris shall be removed from the sewerline and manholes. Methods of cleaning are subject to approval by the County's Representative and the sewer district.

4.4.2.9 CLEANING AND DISINFECTION OF WATER SYSTEMS. After being tested and prior to being placed in service, all lines shall be disinfected by chlorination. Prior to chlorination the entire line shall be flushed to ensure that all dirt or foreign objects have been removed from the line. Sufficient chlorine shall be added to ensure a residual of twenty five (25) parts per million in the water after twenty-four (24) hours standing in the pipe. Chlorine calcium hypochlorite dry chlorinating chemical solution may be used for this purpose. Methods of application shall be approved by the County Representative and applicable water company. Following chlorination, all treated water shall be drained and the pipeline thoroughly flushed with clean water.

All lines being disinfected shall be flushed after the specified twenty-four (24) hour contact period. Such flushing shall be continued until the water is free from excess chlorine. All lines being disinfected including hydrant laterals, branch lines, and dead-end mains shall be flushed. After final flushing the chlorine residual shall be tested by the water company. It is the contractor's responsibility to coordinate this test. The discharge of flushed water shall not cause erosion or damage to streets or other property. Procedures for discharge will be subject to the review and approval of the County's Representative and water company.

4.4.2.10 SPECIAL REQUIREMENTS.

A. **CONNECTIONS TO EXISTING FACILITIES - DRY TAPS.** All connections to existing facilities shall be approved by the County Representative and water company. The Contractor shall make the approved connections to existing facilities as shown on the drawings. Dry connections to existing facilities shall be made only at locations shown on the drawings and shall be made at such times which will cause the least inconvenience to the water user(s). Dry connections shall be planned to minimize the duration of any shut down. The Contractor shall notify the County Representative and water company at least two business days prior to beginning any connections to the existing facilities. When a connection to an existing water main is made, approximately four ounces of high test calcium hypochlorite (HTH) shall

be placed in the pipe at each point where the existing main is cut. All new pipe and fittings at such connections shall be swabbed internally with an approved chlorine solution. All connections shall be made in the presence of the water company representative.

Valves shall not be operated without a water company representative present. Existing facilities shall not be shut down for connections to new facilities without prior water company approval. In no case shall an existing pipeline be shut down for more than eight (8) hours in any twenty-four (24) hour period unless otherwise approved by the County Representative and water company.

The actual work plan and schedule for making a connection to an existing facility which requires an existing pipeline to be shut down, shall be submitted to the County Representative and shall be approved before the Contractor will be allowed to proceed. The Contractor shall notify, by a method approved by the water company, all affected water system customers at least twenty four hours prior to shut down. Valves at connections to all existing facilities shall be operated by the Contractor, but only in the presence of the water company representative. If the water will be shut off for an extended period of time, the water company may require the Contractor to supply water for the water company's customers.

B. **CONNECTION TO EXISTING FACILITIES - WET TAPS** The Contractor shall notify the County Representative and water company a minimum of two (2) business days prior to the time the wet tap is required. No wet taps shall be made without prior approval.

Prior to tapping the main, the tapping valve and fittings shall be properly installed and pressure tested and approved by the water company. The Contractor shall also provide all necessary equipment, labor and appurtenances necessary to complete the job.

4.4.3 QUALITY CONTROL. All underground pipelines shall be installed in accordance with these standards and tested as outlined below. These are minimum requirements and additional testing may be required.

4.4.3.1 TRENCH BACKFILL MOISTURE/DENSITY TESTING. Minimum testing of trench backfill shall be as follows:

Soil Proctor	One determination for each significant change in soil type as necessary to provide required compaction testing. Tests shall be ASTM D-1557 Method A or D (modified proctor).

Trench backfill moisture/ density determination - Tests are required for trench backfill for every two hundred (200) lineal feet of trench or portion thereof and all service laterals, valve locations and manholes. Tests shall be run at the following trench elevations:

One test at top of pipe zone.

One test per two (2) feet of depth measured from the top of the subgrade to the top of the pipe zone. Tests shall be evenly spaced vertically through the trench with one (1) test at top of trench (bottom of subgrade).

Additional testing may be required by the County's Representative or soils testing laboratory to verify compaction.

Tests shall be according to ASTM D-1556 or D-2922 and D-3017. Moisture/density determinations shall be made in accordance with Section 3 of these standards. Proctors for all trench backfill compaction shall be determined using ASTM D-1557 modified proctor method.

4.4.3.2 SANITARY AND STORM SEWER LINE TESTING AND ACCEPTANCE. This subsection specifies requirements for the testing and acceptance of all sewer systems. Prior to testing, all sewer lines shall be cleaned. On main lines, invert elevations of the inlet/outlet of each manhole and the distance measurements between manholes shall be verified with surveying practices prior to installation of manhole floor. For service laterals, grades shall be verified by a carpenter's level or surveying instruments. All sewer trench compaction testing shall be completed and approved prior to performing air and deflection tests. The sewer lines, service laterals and manholes shall be tested for leakage and alignment in the presence of the County's Representative and sewer district as follows:

A. **DISPLACEMENT TEST.** The displacement test shall be conducted by the Contractor in accordance with the following procedure:

A light shall be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned or displaced pipe, or other defects, the defects identified by the County's Representative or sewer district shall be remedied by the Contractor. After cleaning and inspection have been completed, the line shall be tested for leakage.

B. **AIR TESTING.** An air test shall be performed on all sanitary sewer lines as directed by the County's Representative or sewer district. This

test applies to all types of pipe. When concrete pipe is used, it shall be pre-wetted prior to testing.

The reach of pipe to be tested shall be isolated by completely plugging all outlets in the section under test. Careful attention shall be given to blocking all plugs. Prior to installing the lower and upper plugs, any concrete pipe and manholes used shall be wetted to minimize any loss of air through the pipe or manhole walls as a result of permeability in the dry condition. One of the plugs used at the manhole must be equipped to control the air entry rate and to prevent the pressure from exceeding five (5) p.s.i.g. which shall be done by means of a blow-off valve set to operate at five (5) p.s.i.g.

After the plugs are installed (and any concrete pipe has been wetted) the air shall be allowed to slowly fill the pipe until a constant pressure of four (4) p.s.i.g. is maintained for at least two minutes. During the two-minute stabilization period, all plugs and exposed fittings shall be checked with a soap solution. If a leak is found, the air shall be bled off, the leak repaired and a new two minute stabilization period begun. When the temperature of the air has reached equilibrium with that of the pipe wall, the air pressure shall be brought to four (4) p.s.i.g. and the supply shall then be disconnected. When the pressure gauge reaches three and one-half (3 ½) p.s.i.g., a stop watch shall be started. The watch shall then be stopped when the pressure reaches two and one-half (2 ½) p.s.i.g. The time shown on the watch for a loss of one p.s.i.g. at an average pressure of three (3) p.s.i.g. is used to calculate the rate of air loss. The pipeline may be considered to have passed the air test successfully if the loss of air is not greater than a rate of 0.0030 cubic feet per minute per square foot of internal pipe surface. The following table shows the allowable time for the pressure to drop from three and one-half (3 ½) to two and one-half (2 ½) p.s.i.g. for respective pipe diameters.

TABLE 4.6
AIR TESTING

Pipe Diameter	Time Min.	Time Sec.	Pipe Diameter	Time Min.	Time Sec.
6-inch	3	0	18-inch	8	30
8-inch	3	45	20-inch	9	30
10-inch	4	45	21-inch	10	0
12-inch	5	45	24-inch	11	15
14-inch	6	30	27-inch	12	45
15-inch	7	0	30-inch	14	0
16-inch	7	30	36-inch	17	0

C. **EXFILTRATION TEST.** In lieu of the standard air test, the Contractor may make an exfiltration test in accordance with the following procedure:

The test section shall be plugged at both ends and the pipe subjected to a hydrostatic pressure produced by a head of water at a depth of three feet above the invert of the sewer at the upper manhole under test. In areas where ground water exists, the head of water shall be three feet above the existing water table.

For concrete pipe, the three foot head of water shall be maintained for a period of one hour to obtain full absorption of the pipe body and thereafter for a further period of one hour for the actual leakage test. For all other types of pipe, the three foot head of water shall be maintained for a period of one hour only. During the one hour test period the measured maximum allowable rate of exfiltration for any section of sewer, including service stubs, shall be as listed below.

TABLE 4.7
EXFILTRATION TEST

Sewer Main Diameter (inches)	Maximum Drop in Head in a 4-ft. Diameter Manhole (Non-taper sect.) per 100 ft. of sewer pipe	Maximum Allowable Leakage (Exfiltration) (Gallons/Hour/100 ft.)
6	0.1563 inch	1.2
8	0.2031 inch	1.6
10	0.2500 inch	2.0
12	0.3125 inch	2.4
15	0.3594 inch	2.8
18	0.4063 inch	3.2
21	0.4531 inch	3.6
24 or larger	0.5156 inch	4.0

When measurements indicate an exfiltration greater than the maximum allowable leakage, additional measurements shall be taken and continued until all leaks are located and the necessary repairs and corrective work have reduced the leakage in the section being tested below the maximum allowable by these standards. For purposes of the exfiltration test, the line between adjoining manholes will be considered a section and will be tested as such. The Contractor shall furnish the plugs and other material and labor for placing the plugs in the sewer and shall assist the sewer district in making all measurements required. The introduction of any substance into the testing water with the intent of sealing leaks will not be permitted.

When the results of the air test or the exfiltration test is not satisfactory,

repairs or pipe replacement shall be required until the sewer district is satisfied that the leakage requirements have been met. All repair methods and materials used shall be approved and accepted by the County's Representative and sewer district.

D. **PVC DEFLECTION TEST.** All PVC sewer pipe shall be tested for deflection with a mandrel. The mandrel shall be a rigid device sized to pass through a pipe having five (5) percent or less deflection. These allowances shall include deformations due to all causes (wall thickness variations, shipping, production, backfill, heat, etc.). The mandrel device shall be cylindrical in shape and shall comply with the manufacturer's recommendations.

The mandrel shall be hand pulled through all sewer lines. Any sections of sewer not passing the mandrel shall be uncovered and repaired by the Contractor. The Contractor shall re-round or replace the sewer to the satisfaction of the County's Representative and sewer district. All repaired sections shall be re-tested as noted above.

Deflection tests shall be conducted only after the final trench backfill is placed to final subgrade and compacted.

E. **INSPECTION AND FLUSHING.** Prior to final acceptance of each section of sanitary and storm sewer lines, all lines shall be flushed by the Contractor. All dirt and debris shall be prevented from entering the existing sewer system by means of water-tight plugs or other suitable methods.

Upon completion of the project, the sewer district will carefully inspect all sewers and appurtenances by means of camera and video. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the sewer lines and manholes shall be left smooth, clean, and free from any obstructions throughout the entire line. All manhole rings and covers shall be adjusted to finished grade, concrete collars installed, and all sanitary sewer laterals shall be properly extended, capped and marked prior to acceptance of the sewer system.

F. **MANHOLE LEAKAGE TEST.** Sewer manholes located in areas of ground water or probable flooding or if their water tightness is suspect, as determined by the County's Representative or sewer district shall be tested for leakage prior to acceptance. The contractor shall perform all testing. Allowable leakage shall be one gallon per hour per manhole. At least two manholes shall be tested, and based on these tests and visual inspection of all manholes, additional tests may be required for other manholes. Any manhole which tests unsatisfactorily shall be repaired and retested until satisfactory results are obtained.

4.4.3.3 WATER SYSTEM TESTING AND ACCEPTANCE. The Contractor shall test all water mains prior to final acceptance. Testing shall be done in the presence of the County Representative and water company. When existing facilities must be included in the test and are determined to be faulty and not capable of holding test pressures, the existing facilities must be repaired prior to testing. When concrete thrust blocks are used, they shall be in place at least five days prior to initial filling of the line. (If high early strength concrete is used, three days will be required.)

A. **PRESSURE TEST.** After the pipe has been laid, including fittings, valves, corporation stops, services, and hydrants, and the line has been backfilled in accordance with these standards, each valved section, unless otherwise directed by the County Representative and water company, shall be subjected to a hydrostatic pressure test of not less than two hundred (200) pounds per square inch. A maximum of 1,000 linear feet of pipe shall be tested at one time. The duration of each such test shall be two hours. Water added to maintain the pressure shall not exceed 0.3 gallons per inch diameter per one thousand lineal feet of pipe being tested during the two hour test period.

Each valved section of pipe shall be slowly filled with water, and the specified test pressure measured at the lowest point of elevation. The pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus for the test must be furnished by the Contractor. Gauges and measuring devices must be approved by the County Representative and water company and the necessary pipe taps shall be made as directed. Before applying the specified test pressure, all air shall be expelled from the pipe by a method approved by the County Representative and water company.

Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced with new materials in accordance with the standard specifications. The test shall be repeated until the water main passes the pressure test and is accepted by the County Representative and water company.

B. **OPERATIONAL INSPECTION.** At the completion of the project and in the presence of the County's Representative and water company, the Contractor shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are operational; that all hydrants operate and drain properly and that water is available at all meter boxes.

C. **TEST RESULTS AND CERTIFICATES OF COMPLIANCE.** Test results shall be submitted for pressure and operational testing in accordance with current County and water company requirements. Certificates of compliance from material suppliers may be required, at

the option of the County's Representative, for any materials not specifically covered herein.

4.5 ROADWAY CONSTRUCTION. This subsection covers roadway construction including subgrade, subbase, roadbase, recycled aggregate materials (RAM), prime coat, tack coat, plant mix bituminous surfaces (dense and open graded), construction staking and other related work.

4.5.1 GENERAL REQUIREMENTS. The Contractor shall furnish all labor, material, equipment, tools, transportation, traffic control and supplies required to complete the work in accordance with the approved plans and these specifications.

The Contractor shall arrange the work and shall place and dispose of the materials being used so as not to interfere with the public during the course of the project. The Contractor shall join the new work with that of existing in an acceptable manner and shall perform all work in proper sequence.

The Contractor shall provide and maintain or have provided for, all necessary work zone traffic control in accordance with the requirements of Section 2.5 of these specifications. The Contractor shall also maintain the job site and all adjoining private and public areas in a clean, safe manner. This maintenance shall constitute continuous and effective work prosecuted day-by-day, with proper equipment and adequate work forces to keep all areas related to and adjoining the job site in a condition satisfactory to the County's Representative. If, at any time, the Contractor fails to comply with these provisions the County's Representative will immediately notify the Contractor of such n.

If a condition develops due to a lack of maintenance by the Contractor that is dangerous to public safety, the Contractor shall proceed to immediately remedy the condition with whatever means are available. The project may be stopped until these corrections are made. The cost of the corrective remedy will be the Contractor's responsibility

4.5.2 CONSTRUCTION STAKING. Construction stakes shall be furnished and set, establishing lines and grades for roadway excavation including, but not limited to all cut and fill slopes, finished subgrade, finished subbase and finished roadbase grades for streets, curb & gutter, cross-gutters, sidewalks, drive approaches, any contiguous structures and utilities (to help prevent conflicts of location). In development related projects the Developer and his Engineer shall be responsible for all surveying and the accuracy thereof.

The line and grade stakes shall be, whenever possible, off-set from the construction area a minimum of five feet, and shall show the stationing (corresponding with the approved plans), off-set distance, required cut or fill to the finished grade, flow line, or Top Back of Curb (TBC) as indicated on the approved plans. Grade stakes with hubs set to the finished grade of the

subgrade shall be painted appropriately. Stakes with hubs set to the finished grade of the subbase or roadbase shall be painted appropriately. Plastic "whiskers" may be used in connection with painted hubs. All stakes and grades shall be set by appropriate methods under the direction of a professional engineer or licensed surveyor. The Contractor and the County Representative should be provided with copies of the cut sheets generated during construction staking. Cut sheets shall include roadway stationing, reference elevations, grade elevations, etc.

The line and grade stakes and cut sheets along with the most current set of approved plans shall constitute the field control by which the work shall be executed.

The Contractor shall be responsible for preserving property markers, corner survey markers, construction survey stakes and marks for the duration of their usefulness.

If any construction survey stakes or markers are lost or disturbed and need to be replaced, such replacement shall be done at no expense to the County. At no time shall a permanent monument be removed without prior authorization by the County Surveyor. When construction work encounters such monuments, the County Surveyor should be contacted immediately.

4.5.3 GRADE CONTROL SYSTEMS. Non-contact grade control systems may be used to establish the roadway elevations of subgrade, subbase and roadbase on public streets providing the following conditions are met.

A. The system shall be equipped with a "self diagnostic" function that continuously monitors all system functions and shuts the system down if an error in the system occurs. It shall also be equipped with a "thermistor" to electronically compensate for differences in air and ground temperature with a minimum operating range not less than zero to 160° F.

B. The system shall meet the following minimum specifications:

- Blade slope sensor resolution 0.01% slope
- Main fall sensor resolution 0.01% slope
- Rotation sensor resolution 0.1 degree
- Tractor grade controller +/- 0.015 foot accuracy
- Cross-slope resolution 0.1% slope or 0.01 foot/10 foot
- Cross-slope system accuracy 0.02 foot/10 feet
- C. A system meeting the above requirement must be properly installed on a “tight“* properly maintained motor-grader.

- * Meeting the equipment manufacturer's service specification tolerances for all controlling surfaces and connecting points that affect the ability of that specific type of equipment to provide proper grade control.

With all the above conditions met the system will be permitted to be used, providing a preset grade and line for curb & gutter, edge of pavement or curb grade line has been established by the Engineer.

The County's Representative has the right to prohibit the use of such equipment, if in his opinion; the equipment has not been properly maintained or is not being properly operated.

4.5.4 GEOTECHNICAL INVESTIGATION. A geotechnical investigation shall be conducted under the direction and control of a Geotechnical Engineer experienced in flexible pavement design. The investigation shall include a thorough exploration and sampling program of the subgrade to determine the nature and engineering properties of the on-site soils within the roadway construction areas. The minimum sampling and testing requirements shall be as outlined in Section 3.2.5 and where otherwise outlined in these specifications.

The structural details shown on the plans and/or Standard Drawings, and Table 4.8 are minimum requirements. The actual structural section for each roadway shall be designed by accepted engineering design methods for flexible pavement (current AASHTO, UDOT, or Caltrans methods are acceptable) and must be approved by the County Representative prior to construction. Required subgrade soil properties shall be obtained from an on-site geotechnical investigation. Required traffic design traffic information is provided in Table 4.8. When, in the opinion of the County representative the traffic information listed is inappropriate for the street under consideration the Traffic Index will be adjusted accordingly.

4.5.5 ROADWAY SUBGRADE. This subsection shall govern the preparation of natural, filled or excavated material prior to placement of subbase. The preparation of subgrade shall extend a minimum of two feet beyond the proposed construction limits. This includes roadways, curb & gutters, drive approaches, sidewalks or any other roadway structures.

4.5.5.1 PREPARATION. The subgrade soils shall be prepared by scarifying and processing to a minimum depth of one (1) foot unless otherwise recommended by the approved geotechnical study.

Unsuitable material found below the processing depth such as saturated soils from groundwater, expansive soils, soluble soils, deleterious and/or organic materials shall be addressed by a Geotechnical Engineer who shall provide a written recommendation to the County's Representative for approval prior to performing any work in the areas being addressed.

TABLE 4.8
Minimum Roadway Structural Requirements

Classification	Traffic Index	Roadway Minimum Asphalt Pavement Thickness (inches)	Roadway Minimum Roadbase Thickness (inches)	Sidewalk Minimum Concrete Thickness (inches)	Sidewalk Minimum Roadbase Thickness (inches)	Driveway Minimum Concrete Thickness (inches) within R/W	Driveway Minimum Roadbase Thickness residential (inches) within R/W
Residential	5	3 (1)	6	4	4	6	6
Collector	6	3 (1)	8	4	4	6	6
Arterial	8	4	8	4	4	8	8

(1) Asphalt pavements containing more than 1% gypsum ($CaSO_4+2H_2O$ calcium sulfate, dihydrate) shall be a minimum of 3 1/2" thick; consisting of 2 1/2" thickness of 3/4" dense-graded asphalt base course containing no more than 2% gypsum and 1" thickness of 1/2" dense-graded asphalt wearing course with less than 1% gypsum.

4.5.5.2 TOLERANCES. When subbase material is placed on the subgrade the subgrade tolerance shall not vary more than 0.10-foot from the specified grade and cross-section. However, when roadbase or recycled aggregate materials (RAM) is placed on the subgrade the subgrade tolerances shall not vary more than 0.05-foot from the specified grade and cross-section.

4.5.6 SUBBASE - CLASS I AND CLASS II. All gravel pits supplying aggregate shall be UDOT approved pits. Subbase for all roadways and associated areas shall consist of select materials, either natural or crushed. Aggregate wear shall be less than fifty (50) percent when tested by AASHTO T-96. The material passing the #40 sieve shall be non-plastic per AASHTO T-90. The subbase shall contain no more than three (3) percent gypsum or any other deleterious or organic materials by weight.

Prior to delivering any subbase to any site the supplier shall submit, in writing, a job-mix gradation to the County representative for approval. The job-mix gradation shall have definite single values for the percentage of aggregate passing each specified sieve based on the dry weight of the aggregate. Dry weight values shall fall within the band limits shown in Table 4.9.

Annual job-mix gradations shall be submitted in writing to the County representative for approval prior to January 31 each calendar year or upon selection of new aggregate sources. Any revisions to the approved job mix gradations shall fall within the requirements listed above.

If a supplier does not have an approved job-mix gradation that is current for the aggregate source or calendar year, the “Ideal Gradation” in Table 4.9 will apply.

The subbase mixture placed on projects during one day's operation shall come from a single source. Intermixing from more than one source will not be permitted.

Subbase material shall be deposited and spread in uniform lifts not to exceed eight (8) inches compacted thickness for Class I and six (6) inches compacted thickness for Class II without segregation of size. Each layer shall be compacted for the full width and depth by mechanical means of compaction. When mixing, moistening and placing subbase the moisture content shall be not less than two (2) percent below optimum. However, caution shall be used to avoid over watering to a state of instability. Alternate blading and rolling will be required to provide a smooth, evenly moistened and uniformly compacted course true to cross-section and grade. Locations inaccessible to rolling shall be compacted with mechanically operated hand tampers. The subbase shall be compacted to not less than ninety five percent maximum dry density as determined by ASTM D1557-78 or AASHTO T-180 Method D. Subbase tolerances when compacted shall not vary more than 0.05-foot from the specified grade and cross-section.

TABLE 4.9
SUBBASE AGGREGATE GRADATION

PERCENTAGE OF TOTAL AGGREGATE PASSING				
SIEVE SIZE	CLASS I BAND LIMITS	IDEAL GRADATION	CLASS II BAND LIMITS	IDEAL GRADATION
6"	100	100	- -	- -
3"	90 - 100	95	100	100
2"	80 - 100	90	90 - 100	95
1"	70 - 90	80	70 - 90	80
1/2"	51 - 75	63	51 - 75	63
#4	31 - 65	48	31 - 65	48
#16	16 - 40	28	16 - 40	28
#200	2 - 12	7	2 - 12	7

4.5.7. UNTREATED ROADBASE - ONE INCH AND THREE-QUARTER INCH.
All gravel pits supplying aggregate shall be UDOT approved pits. Roadbase for all roadways and associated areas shall consist of select materials, natural and/or crushed. Coarse aggregate shall be all material retained on the #4 sieve, and shall be crushed stone, crushed gravel, or crushed slag with a minimum of forty (40) percent fractured faces per Federal Lands Highway (FLH) designation T-506-94. Fine aggregate may be a natural, or manufactured, product and shall

pass through a #4 sieve. All aggregates shall be clean, hard, tough, durable and sound containing no more than two (2) percent gypsum and be free from other deleterious and/or organic materials and harmful adherent coatings.

Aggregate wear shall be less than fifty (50) percent when tested by AASHTO T-96 and the material passing the #40 sieve shall be non-plastic per AASHTO T-90. The dry-rodded unit weight shall be at least seventy five (75) pounds per cubic foot per AASHTO T-19.

Prior to delivering any roadbase to any site, the supplier shall submit, in writing, a job-mix gradation and a standard aggregate gradation plot to the County representative for approval. The job-mix gradation shall have definite single values for the percentage of aggregate passing each specified sieve based on the dry weight of the aggregate. Dry weight values shall fall within the band limits shown in Table 4.10**,** and provide a uniform curve when plotted on a standard aggregate gradation chart. The County representative has the right to request modification to the job-mix gradation to provide an acceptable curve. The accepted job mix will then become the target gradation for the aggregate source for the calendar year.

Annual job-mix gradations shall be submitted in writing to the County representative for approval prior to January 31 each calendar year, or upon selection of new aggregate sources. Any revisions to the approved job-mix gradation shall fall within the requirements listed above.

If a supplier does not have an approved job-mix gradation that is current for the aggregate source, or calendar year, the "Ideal Gradation" in Table 4.10 will apply.

The roadbase placed on a project during one day's operation shall come from a single source. Intermixing from more than one source will not be permitted.

Roadbase shall be placed in layers compatible with the equipment and not exceeding six (6) inches in compacted thickness. Where the required thickness is more than six (6) inches the roadbase shall be spread and compacted in two (2) or more layers of approximately equal thickness. Each layer shall be compacted for the full width and depth by mechanical means. When mixing, moistening and placing roadbase the moisture content shall be not less than two (2) percent below optimum. Care shall be used to avoid overwatering. Alternate blading and rolling will be required to provide a smooth, evenly moistened and uniformly compacted course true to cross-section and grade. Locations inaccessible to rolling shall be compacted with mechanically operated hand tampers. The roadbase shall be compacted to not less than ninety five (95) percent maximum dry density as determined by ASTM D-1557or AASHTO T-180 method D. Roadbase tolerances when compacted shall meet or exceed the required minimum thickness and shall not vary more than 0.02 foot from the specified grade and cross-section at the time the asphalt pavement is placed.

When the roadbase surface is used to convey traffic, or is left unpaved for an extended period of time, the contractor shall preserve the integrity and grade and an asphalt prime coat meeting the requirements in Section 4.5.8 shall be applied. When asphalt prime is not used, the contractor shall maintain the roadbase moisture, structural integrity and finish, to the finished tolerances of this subsection.

TABLE 4.10
ROADBASE AGGREGATE GRADATION

PERCENTAGE OF TOTAL AGGREGATE				
Sieve Size	1 Inch Band Limits	Ideal Gradation	3/4 Inch Band Limits	Ideal Gradation
American Standard				
1"	100	100	- -	- -
3/4"	- -	- -	100	100
1/2"	79 - 91	85	- -	- -
3/8"	- -	- -	78 - 92	85
#4	49 - 61	55	55 - 67	61
#16	27 - 35	31	28 - 38	33
#200	7 - 11	9	7 - 11	9

4.5.8 PRIME COAT. Prime coat is generally <u>not</u> required on any County roadways unless otherwise required by the County representative. If a prime coat is used, then the air temperature must be 70^0F and rising. This work shall consist of preparing and treating an existing aggregate base with bituminous material and blotter material**,** if required. The type and grade of bituminous material shall be MC-70 liquid asphalt, unless otherwise approved by the County's Representative.

The Contractor shall provide equipment for heating and applying the bituminous material. The asphalt distributor shall be so designed, equipped, maintained and operated that bituminous material will be applied uniformly on variable widths of surface at readily determined and controlled rates.

Bituminous material shall not be applied on a wet surface that has free standing water, or when the atmospheric and surface temperature is less than 70^0 F or when weather conditions, in the opinion of the County's Representative, would prevent the proper application of the prime coat.

Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained, not more than one-half of the width of the section shall be treated in one application. Traffic will not be allowed on the treated surface until the bituminous material is absorbed and will not adhere to the vehicle tires. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Skipped areas or deficiencies shall be corrected.

Application rate shall be 0.25 gallon per square yard, or as directed by the County's Representative. At the time of placement, the temperature of the liquid asphalt shall be uniform and not less than 120° F or more than 180° F.

If the bituminous material fails to penetrate within forty-eight hours, blotter material shall be spread as required to absorb any excess bituminous material. All loose blotter material shall be completely removed from the treated areas prior to placing surfacing material. Prior to placing asphalt concrete, additional prime coat shall be applied as directed by the County's Representative to areas where the prime coat has been damaged, and loose or extraneous material shall be removed.

Sand blotter material shall be clean and meet the following gradation requirements.

GRADATION REQUIREMENTS
Percentage by Weight

Sieve Sizes		Passing Sieve
½ Inch	.....	100
No. 4	.....	90 - 100
No. 16	.....	30 - 75
No. 200	.....	0 – 12

4.5.9 TACK OR FOGSEAL COAT. This work shall consist of preparing and treating an existing bituminous or concrete surface with asphaltic emulsion. The type and grade of bituminous material shall be SS-1h asphalt emulsion, unless otherwise directed.

Asphalt emulsion used as a tack coat between courses of plant mix surface, or over an existing surface, shall be prepared for application by using warm water to cut back the emulsion in the quantity of fifty (50) percent of the emulsion by weight.

Bituminous material shall be applied to the width of the section to be tacked by means of a pressure distributor in a uniform, continuous spread. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Skipped areas or deficiencies shall be corrected.

The Contractor shall provide equipment for heating and applying the bituminous material. The asphalt distributor shall be so designed, equipped, maintained and operated that bituminous material will be applied uniformly on variable widths of surface at readily determined and controlled rates.

Application of tack coat may occur only when the surface and air temperature is 50° F and rising. The surface shall be clean, dry, free of irregularities, and shall be smooth and uniform.

At the time of placement, the temperature of the asphaltic emulsion shall be uniform and not less than 75 degrees F or more than 130 degrees F. The tack shall be applied at a rate of 0.05 to 0.10 gallon per square yard. The rate of application may be adjusted by the County's Representative.

4.5.10 DENSE-GRADED ASPHALT AND RECLAIMED ASPHALT PAVEMENT (RAP). This work shall consist of mixing, laying and compacting an asphalt course of one or more layers composed of aggregate, asphalt cement, applicable additives and lime, as required. All materials shall be mixed at a central mixing plant (plantmix). When a ¾" mix design is used for a surface course, a fogseal shall be applied. The proportion of reclaimed asphalt pavement (RAP) used in the mix shall not exceed fifteen (15) percent.

4.5.10.1 ASPHALT DESIGN. Prior to delivering any plantmix asphalt to any site, the supplier shall submit, in writing, a job-mix formula to the County representative for approval. The job-mix formula shall be determined by a testing laboratory under the direction and control of a Registered Professional Engineer, based on tests performed in accordance with the "Marshall Method of Mix Design" as described in the Asphalt Institute Manual No. 2 latest edition. The job-mix formula asphalt shall satisfy all design criteria as shown in Table 4.11.

Annual job-mix formulas, together with test reports, shall be submitted in writing to the County representative for approval prior to January 31 each calendar year, or upon selection of new job-mix formulas or when there is a change in the source of materials or a change in the percentage of RAP used in the mix. The test report shall give the recommended asphalt content and the values for unit weight, stability, flow, air voids, voids filled with aggregate, voids in mineral aggregate, and indirect tensile strength. Any revisions to the approved formula shall fall within the requirements listed above.

TABLE 4.11
MARSHALL DESIGN REQUIREMENTS

TRAFFIC CATEGORY*	I		II	
ASTM D-1559 (number of blows)	75		50	
TEST PROPERTY	MIN	MAX	MIN	MAX
MARSHALL STABILITY, LB.	1500	- -	1200	- -
FLOW, 0.01 IN	8	16	10	18
AIR VOIDS: PERCENT	3	5	3	5
VOIDS IN MINERAL AGGREGATE (VMA)	13	17	13	17
FRACTURED FACES RETAINED ON THE NO. 4 (4.75 mm) SIEVE PER FLH DESIGNATION: T-506-94 2.1	100%	- - -	75%	- -
SAND EQUIVALENT PER AASHTO T-176-86 (1993) 4.3.2, 4.3.3	55	- - -	40	- -
WEAR TEST AASHTO T-96	- - -	30%	- - -	30%
DRY-RODDED UNIT WEIGHT AASHTO T-19	AM. STD. 75 pounds per cubic foot minimum			
STRIPPING TESTS: AASHTO T-283 ASTM D-4687 including Note 5	Shall be used to determine the required amount of hydrated lime or anti-stripping agent in the asphalt. The mix design shall have a tensile strength minimum of 70 percent.			

* Traffic Category I applies to arterial streets or truck routes with a Traffic Index of seven (7) or more.
Traffic Category II applies to streets with a Traffic Index of less than seven (7).

4.5.10.2 ASPHALT CEMENT. Viscosity graded asphalt cement shall meet AASHTO designation M-226. Viscosity is to be measured at 140°F when used in pavement construction. The asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 350° F. Sampling and testing of asphalt cements shall be in accordance with the following AASHTO Standard Methods:

- Sampling T40

- Viscosity at 140°F T202
- Viscosity at 275°F T201
- Penetration T49
- Flash point (COC) T48
- Solubility in bituminous materials T44
- Thin-film oven test T179
- Ductility T51
- Spot test T102
- Rolling thin film oven test T240
- Water T55

The asphalt cements shall conform to the requirements given in Table 4.12.

TABLE 4.12
Paving Grade Liquid Asphalt Requirements

	AC-10	AC-20	
Viscosity: 140°F poises	1,000 ± 200	2,000 ± 400	
Viscosity: 275°F, Cs-minimum	250	300	
Penetration: 77°F, 100g, 5 sec-min.	80	60	
Flash Point: COC, (°F) -minimum	425°	450°	
Solubility in trichloroethylene: percent-minimum	99.0	99.0	
Tests on residue from thin-film oven test:			
Loss on heating: percent - maximum (1)	0.5	0.5	
Viscosity: 140°F, poises-maximum	4,000	8,000	
Ductility: (77°F, 5 cm per minute), cm-minimum	75	50	
Spot test (when and as specified) (2) with: Standard naphtha solvent		Negative for all grades	

1. The use of loss on heating requirement is to be used only if required by the County representative.
2. The use of the spot test is to be used only if required by the County representative.

4.5.10.3 SHIPMENT OF ASPHALT MATERIAL. Asphalt cement shall be uniform in appearance and consistency and show no foaming when heated to the specified loading temperature. Shipments of asphalt shall not be

contaminated with any other type or grade of asphalt material. A bill of lading shall accompany each shipment of material and shall include the following information:

- Type and grade of material.
- Type and amount of additives used, if applicable.
- Destination.
- Consignee's name.
- Date of shipment.
- Truck identification.
- Loading temperature.
- Net weight or net gallons corrected to 60°F.
- Specific gravity.
- Bill of lading number.
- Manufacturer of asphalt material.

4.5.11 HYDRATED LIME FOR ASPHALT MIXTURE. The physical properties of hydrated lime shall conform to ASTM C-1097, subparagraph d.1; use test method ASTM C-110, paragraph 6.

The water used in saturating the aggregate to be coated shall be potable or water that is clean and free of dirt, silt and other damaging material. The aggregate bulk specific gravity (saturated-surface-dry (SSD)) shall be not less than one and one-half (1½) percent or more than three (3) percent using AASHTO T-85 for the course aggregate retained on a No. 4 sieve and AASHTO T-84 for the fine aggregate passing the No. 4 sieve. Hydrated lime shall be applied at a rate determined during the Marshall Design requirements in Table 4.12, unless otherwise directed by the County representative. Two options for coating the aggregate with lime are as follows:

A. Aggregate shall be monitored for SSD by taking a belt cut between the stockpile and the pugmill or drum. The pugmill or drum shall be equipped with metering devices that will introduce the required amount of hydrated lime and water into the mixer to produce an aggregate SSD of one and one-half (11/2) percent to three (3) percent.

B. Use of lime slurry of one (1) part lime and three (3) parts water by volume may be used, if the plant is equipped with a mixing chamber that can maintain the lime suspension in the slurry. Spraybars for introducing the required quantity of slurry into the mixer shall be equipped with a positive shutoff. If this option is used, the aggregate stockpile shall be maintained at two (2) percent SSD.

Asphalt plants shall provide a positive signal system that automatically closes down the cold feed when the appropriate amount of hydrated lime and water ceases to be introduced into the aggregate. This shall be accomplished by the use of interlocked and synchronized metering devices

and feeders. The plant shall be equipped in such a way that the quantity of hydrated lime incorporated into the mix can be readily checked at any time.

4.5.12 AGGREGATE. The requirements for crushed rock, rock dust, gravel, stone, slag, and sand are included in this subsection. All aggregate shall be clean, hard, sound, durable, and uniform in quality. The quality of soft, friable, thin, elongated, laminated pieces and disintegrated materials will be determined by the supplier's professional Geotechnical Engineer at the time the mix design is submitted, at which time the County's Representative will have the option to approve or reject the material. Organic matter, oil, alkali or other salts shall not exceed two (2) percent total weight. In the surface course this material may be restricted to less than one (1) percent by weight.

A. Aggregate for three-quarter (3/4) inch Category I (NR), (see Table 4.13) shall be one hundred (100) percent crushed material (all manufactured). This is considered a non-rutting (NR) mix.

B. Coarse aggregate for three-quarter (3/4) inch standard and one-half (½) inch Category II (see Table 4.13) shall be retained on the No. 4 sieve and shall have no less than seven-five (75) percent fractured face material as defined in FLH T 506-94 2.1.

C. Fine aggregate for other than the three quarter (3/4) inch NR, may be a natural or manufactured product. It shall pass the No. 4 sieve. It shall be clean, hard-grained angular, non-plastic, and have no more than two percent by weight of organic matter or other detrimental substances, including gypsum.

1. Surface courses, or asphalt wearing courses, shall be free from organic materials and contain less than one percent by weight of soluble minerals, such as gypsum, and phosphates.

TABLE 4.13
DENSE-GRADED ASPHALT AGGREGATE GRADATION

PERCENT OF TOTAL AGGREGATE PASSING (DRY WEIGHT)				
TRAFFIC CATEGORY		I	II	
		3/4 inch NR*	3/4 inch std.*	1/2 inch
SIEVE SIZE (American Standard)				
	1 inch	---	---	---
	3/4 inch	100	100	---
	1/2 inch	74 - 99	---	100
	3/8 inch	69 - 91	75 - 91	---
	#4	49 - 65	46 - 62	60 - 80
	#8	33 - 47	---	---
	#16	21 - 35	22 - 34	28 - 42
	#50	6 - 18	11 - 23	11 -23
	#200	2 - 6	5 - 9	5 - 9

* When a ¾" mix design is used for a surface course, a fogseal shall be applied.

4.5.13 STORING, MIXING AND SHIPPING OF PLANT MIX BITUMINOUS PAVEMENTS. Hot mix plants may be batch or drier-drum type plants (with not less than four aggregate bins). All storing, mixing, and shipping of plant mix bituminous asphalts shall conform to current UDOT and AASHTO requirements.

4.5.14 ASPHALT CONCRETE SURGE AND STORAGE SILOS.
Storage silos shall be well insulated and equipped with heated discharge cones and well sealed discharge gates. Dense-graded asphalt may be stored up to forty eight (48) hours in silos with heated cones, and seventy two (72) hours with heating of the silo vertical walls and cone.

Storage silos may be used for storage or surge purposes, but under no circumstance may a surge silo be used for storage. Either silo must be equipped with high and low indicator systems.

4.5.15 SHIPPING ASPHALT MIXTURES. Trucks used for hauling mix shall have tight, clean, smooth beds which are treated to prevent the mix

from adhering to the bed. Amounts of solution that form visible pools in the truck bed shall be removed prior to loading asphalt mix.

Asphalt mix shall be deposited in a mass into the haul truck in such a way as to prevent segregation.

4.5.16 SURFACE PREPARATION FOR ASPHALT OVERLAYS. Prior to placing asphalt overlays, all manholes, utility covers, monuments and other items affected by the paving operations shall be located, referenced and protected. The existing asphalt surface shall be thoroughly cleaned of all deleterious materials and brought to a uniform grade by spot leveling or by the application of a bituminous leveling course to the surface. A bituminous tack coat shall be applied to the existing prepared surface immediately prior to placing the finish asphalt course in accordance with Section 4.5.9 of these specifications. It may be required to remove a section of pavement at each end of the overlay to create a smooth transition onto existing asphalt. A minimum eight (8) foot wide section must be removed. Edges of the section must be saw-cut prior to removal. Feathering of the overlay onto existing asphalt will not be permitted.

4.5.17 ADJUSTMENT OF MANHOLE AND UTILITY COVERS. Prior to paving and after roadbase is placed, all manholes and utility covers shall be brought to the base grade. Damaged valve boxes, covers, grade rings, cones, flattops, risers, or other damaged items shall be replaced. Manhole cones or flattops that are more than eighteen inches below finish grade shall be raised by using risers etc. under the cone or flattop. Existing roadbase shall not be contaminated with soil or subbase. Backfill material around adjusted manholes and utilities shall comply with roadbase standards meeting Section 4.5.7 of these specifications, and be compacted to ninety five (95) percent as determined by ASTM D-1557 or AASHTO T-180 Method D. When paving is complete, all manhole and utility covers shall be raised to finished grade, including concrete collars, in accordance with standard requirements.

4.5.18 ASPHALT PAVING EQUIPMENT. A self-propelled paver with a screed unit that provides a smooth, steady pull on the screed arms shall be used. The screed unit shall strike off, partially compact, and iron the surface of the mat at least twelve feet wide. The screed unit shall be equipped with automatic controls and heaters and vibrators. The screed plate must be smooth and not excessively worn. All screed extensions shall be ridged, or hydraulically extendable. The screed extensions shall maintain the proper elevation and angle of attack to the main screed at all times and shall also be heated and provide vibration. Augers shall adequately feed all areas of the extended screed.

The automatic screed controls shall be full contact electronic or non-contact ultrasonic grade control systems. These systems shall be adaptable to a

floating-beam system a minimum of thirty feet long. The floating-beam shall be equipped with shoes that are allowed to rotate and can be individually displaced by isolated disruptions in the existing surface without changing the height of the whole beam. The automatic grade sensor shall be set at the midpoint of the floating beam.

Ultrasonic grade control systems may be used without the floating beam on all Traffic Category II streets unless otherwise directed. The ultrasonic grade control system must meet the following conditions in order to be used without the floating beam.

The system shall be equipped with a “self diagnostic“ function that continuously monitors all system functions and shuts the system down if an error in the system occurs. It shall also be equipped with a ”reference bail“ to electronically compensate for differences in air and ground temperature with a minimum operating range not less than zero to 160 degrees F.

The system shall perform to a minimum of the following specifications:

Ultra sonic grade controller:

- On-grade tolerance +/- 0.01 foot
- Resolution 0.001 foot
- Operating range 10 in. to 42 in.
- Mat thickness control 0.01 foot

Slope controller:

- Correction window - 1.0%
- On-grade tolerance - 0.1%
- Resolution - 0.01%
- Operating range 0.0% to 100%.

The systems meeting the above requirements must be properly installed on a “tight”, properly maintained self-propelled paver with a screed unit. A “tight” system shall meet the equipment manufacturer's service specification tolerances for all controlling surfaces and connecting points that affect the ability of that specific type of equipment to provide proper grade control.

The County’s Representative has the right to prohibit the use of such equipment if in his opinion the equipment has not been properly maintained or is not being properly operated.

If the automatic grade control becomes inoperative, the Contractor may finish the day's work using manual controls provided the required grade, thickness and smoothness tolerances are met. Paving shall not continue on the project, or any new project, until the automatic control system has been repaired.

4.5.19 ROLLERS. Rollers shall be vibratory, steel-wheeled double-drum with a static weight of not less than 10 tons for breakdown rolling. Pneumatic-tired rollers with a minimum operating weight of two thousand (2000) pounds per tire shall be used for intermediate rolling and leveling course compaction. The roller shall be in good condition, and capable of reversing without backlash. The number of rollers shall be sufficient to compact the asphalt mixture before it cools below 175°F. Finish rolling may be performed with the breakdown roller in the static mode, or with a steel-wheeled roller of sufficient size to remove the roller marks in the finished surface. If a roller breaks down and a back-up roller is not available, paving operations shall stop until adequate rollers are available.

4.5.20 WEATHER AND DATE LIMITATIONS. Asphalt shall not be placed during the period from November 1st through April 30th unless otherwise approved by the County representative. Paving approved during this time shall conform to winter paving requirements and policies. Minor repairs and patching may be allowed during winter months.

The asphalt mixture shall not be placed upon any wet surface, or when the air and surface temperature of the underlying course is less than specified in Table 4.14. The temperature requirements may be modified, but only when so approved and directed by the County representative. If a prime coat is used, then the air temperature must be 70^0F and rising. Air and roadbed temperature shall be measured in the shade. Asphalt mixtures shall not be placed during adverse weather conditions such as rain, wind, hail, etc.

TABLE 4.14
CLIMATE LIMITATIONS

Mat Thickness	Minimum Air and Surface Temperature F
3 inches or greater	50°
Less than 3 inches	55°
Open graded asphalt mix	70^0

4.5.21 SPREADING AND FINISHING. The asphalt mix shall be placed upon an approved surface, by a self-propelled paver meeting the requirements in Section 4.5.18. The travel rate of the paving machine shall be regulated to a speed dependent upon the capacity of the mixing plant and/or trucking service to supply the mixture. The paving machine shall be

operated so that material does not accumulate and cool below 250° F along the sides of the receiving hopper.

Where unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture may be spread, raked with hand tools, and mechanically compacted. For such areas, the mixture shall conform to the required mix design, density, compacted thickness, grade and cross section.

The asphalt mix may be windrowed in front of the self-propelled paver properly equipped to transfer the asphalt mix directly into the hopper, provided that the following conditions and requirements are strictly adhered to:

The windrow is properly sized, thereby insuring the delivery of the correct amount of material to the paving machine at all times.

The asphalt mixture shall be transferred from the windrow to the paving machine in such a manner that the materials in the paver will be a uniform mixture. The base, upon which the windrow was formed, shall not be disturbed. There shall be a minimum amount of asphalt mixture remaining on the base between the pickup device and the paving machine.

The material in the hopper of the paving machine shall meet with the temperature requirements. Asphalt mixture that does not meet the minimum specified temperatures shall not be used, and shall be properly disposed of.

When it is determined by the County Representative that the asphalt course being placed by use of a windrow is inferior to that being placed by direct transfer of the asphalt from the hauling vehicle to the spreading machine, the use of the windrow method shall be discontinued.

The asphalt mixture placed by the use of a paving machine during one day's operation shall come from a single plant manufacturer. Intermixing from more than one source shall not be allowed. Intermixing is defined as when more than one plant is used as a routine supply source to a single operation.

The asphalt mixture shall have a temperature not less than 250°F nor more than 325°F, at the time the paving machine places the asphalt mixture on grade. Depending on environmental conditions and compaction requirements, the County's Representative may specify more strict temperature requirements.

Asphalt pavement courses of more than three and one-half (3 ½) inches in total compacted thickness shall be placed in two or more courses. One

course shall not be placed over another course until the compaction requirements have been met and the mat temperature has cooled to 160°F at mid-depth.

Placing of the asphalt pavement shall be as continuous as possible. Rollers should not pass over the unprotected edge of the freshly laid asphalt mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth and proper grade of that course. A tack coat meeting Section 4.5.9 of these specifications shall be applied on the contact surface of the prepared transverse joints just before the new asphalt mixture is placed.

Longitudinal joints shall be spaced in such a manner that joints in succeeding courses will be offset at least twelve (12) inches horizontally from joints in any preceding course. Lanes will be evened up each day to minimize cold longitudinal joints and to provide proper transverse joints. Where possible, the top course longitudinal joints shall be placed a minimum of one (1) foot either side of the lane line.

Transverse joints shall be spaced in such a manner that joints in succeeding passes will be a minimum of five (5) feet horizontally from joints in any adjacent pass.

Existing roadway pavements to be widened shall be sawcut far enough into the roadway to provide the proper grade, cross-section and thickness with a straight vertical longitudinal or transverse joint. These joints shall have a tack coat meeting Section 4.5.9 of these specifications applied on the contact surface immediately prior to paving.

Longitudinal joints on previously compacted passes should have an overlap of new asphalt mixture one (1) to one and one-half (1 ½) inches over the existing mat. Raking should be merely to "bump" the joint, pushing the asphalt mixture off the previous pass and onto the new pass directly over the joint. If the adjacent mat is overlapped too far and too much asphalt mixture is deposited on the existing mat, the excess material shall be pulled away from the new mat rather than being pushed onto the new mat. Excess mix shall never be broadcast across the newly laid asphalt. The excess mix shall be picked up and recycled.

4.5.22 ROLLING AND COMPACTING. Compaction equipment shall meet the requirements of Section 4.5.19 of these specifications, unless otherwise approved or required by the County's Representative.

A pass shall be one movement of a roller in either direction. A coverage shall be as many passes as are necessary to cover the entire width being paved. Overlap of passes during any coverage, made to ensure compaction without displacement of material shall be in accordance with

good rolling practice.

The breakdown rolling shall consist of one or more complete coverages of the asphalt mat with a vibratory steel-wheeled roller. Initial rolling shall commence at the lowest edge and shall progress toward the highest portion of the asphalt mat. Initial rolling shall not commence on the interior portion of any mat.

The breakdown rolling shall be followed immediately by additional rolling with a pneumatic-tired roller that will provide uniform density throughout the depth of the course being compacted. A minimum of two rollers, one steel-wheeled, and one pneumatic-tired, shall be used. However, the total number of rollers used beyond the minimum of two shall be sufficient to obtain the required compaction while the asphalt mixture is above 175°F.

The final rolling of the asphalt mixture shall be performed by a steel wheel roller of sufficient size to remove all roller marks caused during the compaction of the asphalt mixture. The vibratory roller used for breakdown rolling may be used as the finish roller provided it is operated with the vibratory unit turned off.

The rollers shall be kept in continuous motion while rolling so that all parts of the asphalt mixture will receive as close to equal compaction as possible. The roller speed shall be slow enough at all times to avoid displacement of the pavement. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by use of rakes and fresh asphalt mixture when required.

To prevent adhesion of the asphalt mixture to the rollers, the wheels/tires, bars, pads and release agent pumps shall be kept properly maintained. The use of diesel oil on pneumatic-tired rollers shall be kept to a minimum and used only in conjunction with coca pads to prevent the asphalt mixture from adhering until the tires heat enough to prevent mix adherence.

The completed surface shall be thoroughly compacted, smooth and free from ruts, humps, depressions, or irregularities. Any ridges, indentations or other objectionable marks left in the surface of the finished pavement shall be eliminated by rolling or other means. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the asphalt surface shall be discontinued, and acceptable equipment shall be furnished.

Compacting the longitudinal joint shall be performed by placing the roller on the hot uncompacted mat and overlapping the joint by a distance of approximately six (6) inches over the cold compacted mat. For proper compaction, the level of the uncompacted mix at the longitudinal joint must be above the elevation of the compacted mix by an amount equal to approximately one-quarter (1/4) inch for each one inch of compacted

pavement. A test strip is advisable.

A good source of information for rolling asphalt is a document by AASHTO, FAA, Federal Highway Administration, and the National Asphalt Pavement Association entitled "AC 150/5370-14, Appendix 1, July 31, 1991".

4.5.23 OPEN-GRADED WEARING COURSE.

4.5.23.1 WEARING COURSE. When an open-graded wearing course is placed it shall be placed over a dense-graded asphalt course. The dense-graded asphalt shall be true to line and grade, cleaned and tacked.

The following specifications shall be complied with:

Item	Section
Dense-graded asphalt	4.5.10
Tack Coat	4.5.9
Asphalt Cement for (existing road) Overlays	Table 4.16
Asphalt Cement for New Construction	4.5.10.2
Hydrated Lime	4.5.11
Other related requirements	

Aggregate gradation shall conform to Table 4.15 when tested under AASHTO T-30.

The percent passing the No. 200 sieve will be determined by using AASHTO T-11, test procedures.

That portion of aggregate retained on the No. 4 sieve shall have no more than ten percent rounded particles when tested in accordance with UDOT Test Procedure 8-929.

TABLE 4.15
OPEN-GRADED ASPHALT AGGREGATE GRADATION

SIEVE SIZE		IDEAL GRADATION PERCENT PASSING	IDEAL GRADATION TOLERANCE
AMERICAN			
1/2 inch		100	0
3/8 inch		96	93-100
No. 4		40	35-45
No. 8		17	13-21
No. 200		3	1.3-4.7

TABLE 4.16 RUBBERIZED LIQUID ASPHALT REQUIREMENTS		
AC-20R:		
Property	**ASTM**	**Specification** **Min.** **Max.**
Viscosity @ 140°F, poise Viscosity @ 275°F, cs Pen @ 77°F (100 g, 5 sec) Flash Point, °F, C.O.C. Duct. @ 39.2°F, (5 cm/min) cm Rubber, weight % Toughness, in-lb Tenacity, in-lb Rolling Thin-Film Oven Test Tests on Residue: Viscosity @ 140°F, poise Duct. 39.2°F, (5 cm/min) cm	D-2171 D-2170 D-5 D-92 D-113 * * D-2872 ** D-2171 D-113	1,600 2,400 70 450 50 2.0 110 75 8,000 25
* Benson Method of Toughness and Tenacity: Scott Tester, inch-pounds @ 77°F, 20 inches per minute pull. Tension head 7/8-inch diameter. ** TFOT ASTM D-1754 may be used. The Rolling Thin-Film Circulating Oven Test is the preferred method.		

4.5.23.2 SUITABILITY OF AGGREGATE. The following requirements shall be used to determine the suitability of the aggregate during the mix design:

- Wear shall not exceed thirty (30) percent when tested in accordance with AASHTO T-96.
- The weighted loss shall not exceed twelve (12) percent by weight when subjected to five cycles of sodium sulfate tested in accordance with AASHTO T-104.
- Aggregates consisting mainly of carbonate type rocks shall not be used unless approved by UDOT as satisfactory long-term friction values for comparable traffic volumes when tested in accordance with AASHTO T-242 or ASTM E-274.

Aggregates shall be separated into two or more sizes and stored separately.

Stockpiling or handling methods that cause segregation, degradation or the combining of materials of different sizes when placing the aggregate in storage or moving it from storage to the cold bins shall not be used. Any segregated or degraded material shall be re-screened.

4.5.23.3 MIX DESIGN. Annual mix designs shall be submitted in writing to the County Representative for approval two weeks prior to the first job each calendar year, or upon selection of new aggregate sources. Any revisions to the approved mix design shall fall within the requirements listed above. Open-graded wearing courses that do not meet the tolerances shown in Section 4.5.24 shall be removed and replaced with material meeting the required gradation. The asphalt cement shall be within 0.10 percent of the mix design. At no time shall the asphalt cement content be such that asphalt slicks form on the surface of the roadway.

Based on the mix design, the open-graded wearing course shall have a tensile strength ratio of seventy (70) percent, or greater, in accordance with AASHTO T-283 UDOT modified. Hydrated lime or anti-stripping agent may be added to the asphalt mix to meet the minimum tensile strength of seventy (70) percent.

4.5.23.4 MIXING. The mixing shall be done as in accordance with UDOT specifications. During mixing the viscosity of asphalt shall be maintained between four hundred and nine hundred (400-900) centistokes. The viscosity of polymer-modified asphalt, when used, shall be maintained between one hundred fifty and three hundred (150-300) centistokes.

If a drier-drum mixing process is used, the temperature of the mixture shall not be less than 220°F, or more than 275°F, when discharged from the mixer. When using a polymer-modified asphalt the temperature of the mixture when discharged from the mixer, shall be maintained between 270°F and 320°F. Viscosity will be determined in accordance with ASTM T-201.

4.5.23.5 SURFACE PLACEMENT. Tack coat shall be applied in accordance with Section 4.5.9.

Self-propelled asphalt paving equipment and automatic screed controls meeting the requirements of Section 4.5.18 shall be used. Rollers shall meet the requirements of Section 4.5.19 and shall be a ten (10) ton vibratory operated static or a ten (10) ton static steel wheeled roller for asphalt pavement finishing.

Paving operations should be planned such that all passes will be brought even ”transversely“ at the end of each working day. Joints between old and new pavements, or between successive day’s work shall ensure continuous bond between adjoining work. Construct joints to have the same texture, density, and smoothness as other sections of the bituminous pavement course. Clean contact surface and apply tack coat.

Offset longitudinal joints a minimum of twelve (12) inches in succeeding courses and at least six (6) feet transversely to avoid vertical joints through more than one course. In the top course restrict longitudinal joint to one (1) foot either side of the lane line. Prevent traffic, including construction traffic, from crossing vertical joint edges.

Excessive rolling shall not be allowed. Wearing course compaction shall be completed prior to the mix temperature dropping below 180°F. When using polymer-modified asphalt, compaction shall be completed prior to the mix temperature dropping below 200°F.

Asphalt slicks shall be raked immediately. Slick spots that cannot be removed by raking shall be replaced. All humps or depressions exceeding tolerances shall be corrected. Correction methods shall be approved by the County’s Representative.

All traffic shall be prevented from traveling on the completed wearing course until it has hardened sufficiently and the surface temperature has dropped below 160°F. The thickness of the compacted wearing course shall not vary more than one-quarter (1/4) inch from the specified thickness. Testing and acceptance shall conform to Section 4.5.24.

4.5.24 ACCEPTANCE TESTING REQUIREMENTS AND TOLERANCES. The following subsections list the requirements for testing and acceptance for subbase, roadbase, RAM, dense-graded asphalt, open graded asphalt and asphalt pavement surfaces. Testing documentation shall fully address the requirements of these standards.

4.5.24.1 SUBBASE. The following will be required for testing and acceptance of subbase:

A. One moisture/density test per seven thousand (7,000) square feet of roadway, or fraction thereof.

B. One thickness test hole per five thousand (5,000) square feet.

C. One gradation test per fifteen thousand (15,000) square feet of roadway, or fraction thereof. The allowable deviations from the

approved subbase targets (see Table 4.9) are as follows.

TABLE 4.17
SUBBASE SIEVE SIZE AND DEVIATION

SIEVE SIZE AMERICAN	ALLOWABLE DEVIATION % OF TOTAL AGGREGATE
2" to 6"	+/- 12
1/2" to 1"	+/- 11
3/8"	+/- 10
No. 4	+/- 9
No. 16	+/- 7
No. 200	+/- 3

C.1 One sand equivalent *(SE)* value for every gradation outside the allowable deviation. A CBR or R-value shall be performed on twenty five (25) percent of all sand equivalent test results with a minimum of one test required. Where multiple SE tests are run, the CBR or R-value shall be determined on those SE tests that exhibit the lowest values.

Any remaining samples with gradations outside the allowable deviations must exhibit the required CBR or R values to be accepted.

The Following Are the Minimum Values for Roadway Subbases.

- The minimum acceptable SE value shall be eighteen (18).
- The minimum acceptable R-value shall be sixty (60).[(1)]
- The minimum acceptable CBR value shall be thirty (30).[(2)]

Note 1: R-value test: AASHTO T-190 or ASTM-D 2844 (300 psi exudation pressure)
Note 2: CBR Value Test: AASHTO T-193, (3 point)

4.5.24.2 ROADBASE AND RECYCLED AGGREGATE MATERIALS (RAM).

A. One moisture/density test per seven thousand (7,000) square feet of roadway, or fraction thereof.

B. One thickness test hole per five thousand (5,000) square feet.

C. One gradation test per fifteen thousand (15,000) square feet of

roadway, or fraction thereof. The allowable deviation from the approved roadbase and RAM targets (see table 4.10) are as follows:

TABLE 4.18
ROADBASE AND (RAM) SIEVE SIZE AND DEVIATION

SIEVE SIZE AMERICAN	ALLOWABLE DEVIATION % OF TOTAL AGGREGATE
1/2" to 1"	+/- 11
3/8"	+/- 10
No. 4	+/- 9
No. 16	+/- 7
No. 200	+/- 3

C.1 One (1) sand equivalent *(SE)* value for every gradation outside the allowable deviation. A CBR or R-value shall be performed on twenty five (25) percent of all sand equivalent test results with a minimum of one (1) test required. Where multiple SE tests are run, the CBR or R-value shall be determined on those SE tests that exhibit the lowest values.

Any remaining samples with gradations outside the allowable deviations must exhibit the required CBR or R values listed below to be accepted:

- The minimum acceptable SE value shall be twenty-two (22).
- The minimum acceptable R-value shall be seventy-six (76).[(1)]
- The minimum acceptable CBR value shall be sixty (60).[(2)]

Note 1: R-value test: AASHTO T-190 or ASTM-D 2844 (300 psi exudation pressure)
Note 2: CBR Value Test: AASHTO T-193, (3 point)

4.5.24.3 DENSE-GRADED ASPHALT PAVEMENTS.

A. One density test per seven thousand (7,000) square feet of surface area, or fraction thereof.

B. One core sample per nine thousand (9,000) square feet, or fraction thereof, unless sufficient inspection has been made by the County's Representative to verify required thickness.

C. One (1) extraction and gradation test per days work, or one (1) for every five hundred (500) tons or fraction thereof, whichever is greater.

In the event that the asphalt pavement fails to meet the allowable deviation for extraction or gradation tests, or shows a tendency under traffic loading to rut, tear, or distort, or in the opinion of the County's Representative is "tender" or deficient in appearance, the asphalt pavement shall be cored and tested in accordance with AASHTO T-283or ASTM D 4867 including Note 5.

Asphalt pavement so tested must possess seventy (70) percent of the tensile strength ratio based on the approved Marshall mix design. Asphalt pavement not meeting this requirement requires removal.

The maximum allowable percent of total aggregate deviations from the approved Marshall mix design are:

Asphalt content	+/- 0.46
1/2" and larger	+/- 6.3
3/8"	+/- 5.9
No. 4	+/- 5.7
No. 8	+/- 4.8
No. 16	+/- 4.6
No. 50	+/- 3.8
No. 200	+/- 2.0

4.5.24.4 COMPACTION OF DENSE-GRADED ASPHALT PAVEMENT.

A. Acceptance of dense graded asphalt pavement shall be as follows:

- When the average of all density tests is not less than ninety six (96) percent of the maximum laboratory density (Marshall) and when no single test is lower than ninety two (92) percent of the Marshall.

- When the average of all density testing falls between ninety three (93) percent to 95.9% of the Marshall with no test lower than ninety two (92) percent of the Marshall, the asphalt pavement shall be tested to determine the percent of air voids. If the percent of air voids are between three to five (3-5) percent, the asphalt pavement will be considered acceptable. If the percent of air voids are between five to seven (5-7) percent, the asphalt pavement will require a slurry seal per these specifications.

- When the average of all density testing falls between ninety one (91) percent of the Marshall and 92.9% of the Marshall with no single test below ninety (90) percent of the Marshall, the asphalt pavement <u>shall be</u> overlaid with a minimum of <u>one inch</u> thick asphalt pavement. Prior to the overlay, the existing asphalt next to the curb, gutter, cross gutter, etc. shall be milled three-quarter (3/4) inch below the top edge of the concrete to provide a finished

asphalt surface that is one-quarter (¼) inch above the concrete gutter.

- Asphalt pavements with an average density less than ninety one percent of the Marshall, or with any single test less than ninety percent of the Marshall, shall be removed and replaced.

4.5.24.5 OPEN-GRADED ASPHALT WEARING COURSE.

One (1) extraction and gradation test is required per days work, or one (1) for every five hundred (500) tons or fraction thereof, whichever is greater. In the event that the extraction or gradation fails to meet the allowable deviation, the remaining sample material shall be remolded and tested in accordance with AASHTO T 283 or ASTM D 4867including Note 5. The open-graded asphalt pavement must possess seventy percent of the tensile strength ratio based on the approved mix design. Open-graded asphalt not meeting this requirement requires removal.

The allowable maximum percent deviations from the approved Marshall mix design shall be as follows:

Asphalt content	+/- 0.46
1/2"	+/- 6.3
3/8"	+/- 5.9
No. 4	+/- 5.7
No. 8	+/- 4.8
No. 200	+/- 2.0

4.5.24.6 ASPHALT PAVEMENT SURFACES.

The completed surfacing shall be thoroughly compacted, smooth and free from ruts, humps, depressions, rock pockets or slick spots. Any ridges, indentations or other objectionable marks left in the pavement's finished surface shall be corrected prior to acceptance.

The paving contractor shall provide adequate quality control during spreading and finishing procedures to meet or exceed the following longitudinal and transverse profiles:

- Longitudinal deviations shall not exceed +/- 0.025 foot in 25 feet.
- Transverse deviations shall not exceed +/- 0.01 foot in 10 feet.

- Longitudinal construction joint deviations shall not exceed +/- 0.01 foot in ten (1) feet.

- The completed pavement surfaces shall be constructed to the required grades and cross sections. When pavement surfaces

contact concrete structures such as drainage structures, curbs & gutters, utility vaults, or manholes, the pavement surfaces shall be one-quarter (1/4) inch above the concrete structures.

All deviations exceeding the specified profile tolerances shall be corrected prior to final rolling.

4.6 BITUMINOUS SEAL COAT (CHIP SEAL). Bituminous surface treatments (chip seals) shall be applied to the road surface only when required, or approved by the County representative. The bituminous surface treatment shall consist of an application of bitumen covered with mineral aggregate and rolled to a smooth surface presenting an even texture. The materials used in the application of the bituminous surface treatment shall be bituminous mineral, and mineral aggregate, as specified below.

4.6.1 MATERIAL SPECIFICATIONS.

4.6.1.1 BITUMINOUS MATERIAL. The bituminous material shall be cationic emulsified asphalt with a natural latex rubber material (type LMCRS-2H) and shall conform to the following requirements:

TABLE 4.19
BITUMINOUS MATERIAL

TEST	SPECIFICATION	PARAMETERS
Viscosity @ 122° F.	AASHTO T-59	100-300 sec.
Sieve	AASHTO T-59	0.3% max.
Settlement, 5 days	AASHTO T-59	5% max.
Demulsibility	AASHTO T-59	40% min.
Storage Stability (1 day test)	AASHTO T-59	1% max.
Ash Content	ASTM D3723	0.2% max.
Tests on Residue by Drying:		
Percent Residue	NV 756	65% min.
Penetration @ 77° F., (100 g., 5 sec.)	AASHTO T-49	40-150 mm.
Ductility @ 77° F., (5 cm./min.)	AASHTO T-51	40 cm. min.
Torsional Recovery	NV 756	18% min.
Particle Charge	AASHTO T-59	POSITIVE

4.6.1.2 AGGREGATE (CHIPS). Mineral aggregate shall consist of crushed stone or crushed gravel, free from adherent films of clay or dust, and shall be of such nature that a thorough coating of the bituminous material used in the work will not strip off upon contact with water.

The gravel or rock shall have a percent of wear not greater than thirty (30) when tested by the Los Angeles Abrasion Test (AASHTO T-9 ASTM C 131). Chips shall be cubical or pyramidal in shape with at least ninety-five (95) percent fractured faces. The crushed aggregate shall have a weighted percent of loss not exceeding ten (10) percent by weight when subjected to five (5) cycles of sodium sulfate and tested in accordance with AASHTO Designation T-104.

Stripping tests of the mineral aggregate which the Contractor proposes to use shall be furnished to the County's Representative before crushing operations begin. During aggregate crushing, additional stripping tests shall be furnished to the County's Representative upon request. No stripping test shall show a percent stripping greater than ten (10) for LMCRS-2H asphalt. The chip shall be electrically compatible to the asphalt emulsion used.

The crushed aggregate shall conform to the gradation requirements shown in following table.

TABLE 4.20
GRADATION OF AGGREGATE FOR CHIP SEAL COATS

SIEVE SIZE	PERCENT BY WEIGHT PASSING (Ideal)	IDEAL GRADATION TOLERANCE (Percent)
1/2 Inch	100	0
3/8 Inch	95	+/- 5
No. 4	10	+/- 5
No. 8	2	+/- 2
No. 200	0.5	+/- 0.5

The initial mineral aggregate used for the production of chips shall be retained on a one-inch sieve prior to being crushed to the gradation specified.

4.6.2 AGGREGATE QUALITY CONTROL. Prior to delivery to the project site the designated wear test, stripping test, sodium sulfate test, fracture face count, and gradation tests shall be performed on the crushed aggregate. Each time a source changes said tests will be repeated.

All aggregate (chips) shall be tested for compliance with the gradation and fracture face count during the production of the chips. There shall be no less than one (1) test performed for every five hundred (500) tons of material produced or one (1) day's production, whichever is less. One gradation test and fracture face count test shall be defined as the average results of tests taken on

three (3) different samples taken at one particular time.

All material produced shall be stockpiled in designated stockpile site(s).

When chips are delivered to the project stockpile site there shall be one (1) gradation test conducted for every five hundred (500) tons of material. If the gradation test requirements are not met, the County's Representative may require that the failed material be removed from the stockpile. Chips shall be considered to be out of specification if one test (as defined herein above) fails.

The County's Representative may not accept any chips which do not meet all the designated specifications.

In addition to the random acceptance samples taken at the stockpile, the County's Representative may sample the aggregate from any portion of stockpile which exhibits a non-uniform appearance.

The Contractor shall take immediate steps to bring the aggregate into specifications when test results show any deviation from the established maximum or minimum values for any sieve as shown in Table 4.20 of these specifications.

At designated stockpile site(s), the Contractor may be required to "push up" the unloaded aggregate into piles suitable for loading into the delivery dump trucks.

Extreme care shall be taken so as not to mix any of the crushed aggregate with the underlying material at the stockpile or the crushing site. In the event that there is contamination of the chip seal aggregate with foreign material, as determined by the County's Representative, or by tests conducted, the contaminated section of material shall be immediately removed from the stockpile or crushing area and properly disposed of. All contaminated material removed from the stockpile, or crushing area, shall be replaced with aggregate which meets the requirements of these specifications.

All testing required by the County's Representative, or by the plans and specifications, shall be performed by an independent testing laboratory. The Contractor shall do everything in his power to ensure that the County's Representative has full access to the testing procedure and shall deliver to the County's Representative any and all results of tests run. The Contractor shall not proceed with subsequent construction until certified copies of appropriate tests are delivered to the County's Representative. Any materials not properly tested shall be subject to rejection and removal.

4.6.3 EQUIPMENT. All tools, equipment and machines used in the performance of the work shall be subject to the approval of the County's Representative, and shall be maintained in satisfactory working conditions at all times.

4.6.3.1 ASPHALT DISTRIBUTOR. The asphalt distributor shall be equipped with a calibrated dipstick marked in gallons per inch of length, and an accurate thermometer and speedometer. The distributor shall also be capable of maintaining proper pump pressure to ensure a uniform distribution of liquid asphalt emulsion at all times. The pump shall be able to maintain the correct pump speed, or pressure, without either atomizing the asphalt or distorting the spray fan. However, the pump shall be able to maintain a pressure which shall be sufficient to prevent streaking from a non-uniform discharge of material from the individual nozzles.

The distributor shall be equipped with a rear-mounted spray bar capable of covering widths of six to fifteen (6-15) feet in a single pass. The distributor tank shall be well insulated and be equipped with one or more heaters capable of bringing the asphalt emulsion to spray application temperature. The tank shall have a full circulating system which shall include the spray bar unit. The truck shall also be equipped with a hand-spray for applying the asphalt emulsion to areas that cannot be reached with the spray bar.

The distributor shall be equipped with a computer which will automatically determine the discharge based on the nozzle size, the truck speeds for various application rates, and the corrections for temperature-viscosity variations.

4.6.3.2 AGGREGATE SPREADER. The spreader shall be a self-propelled Flarity chip spreader, or equal, capable of uniformly spreading aggregate at varying application rates as required. The spreader shall be equipped with a tachometer and/or a speedometer to ensure the maintenance of a uniform spreader speed. The aggregate spreader shall also be equipped with a device and so operated that the coarse particles of the screening shall be deposited on the bituminous binder before the finer particles.

4.6.3.3 ROLLERS. The Contractor shall provide at least two (2) self propelled, smooth-tread, pneumatic tired rollers on the job during the chipping operations. Each roller shall weigh at least ten (10) tons and have staggered (offset) front and rear tires to obtain a uniformly rolled pass. Tire pressure in all tires shall be uniform and inflated to eighty (80) psi. No steel wheel rollers shall be used to roll the chip seal surface treatments. Rolling speed shall not exceed ten (10) miles per hour.

4.6.3.4 DUMP TRUCKS. The Contractor shall provide sufficient ten-wheel dump trucks during the chip sealing operations to ensure that the project can proceed without interruption. Frequent stops and starts during the chip seal operation will not be permitted.

4.6.3.5 LOADERS. The Contractor shall have on hand at least one loader to load the aggregate into the dump trucks from the aggregate stockpile(s).

4.6.3.6 POWER BROOMS. The Contractor shall provide at least one self-propelled rotary power broom or sweeper at the job site, and shall use said sweeper (supplemented with hand brooms as necessary) as required, to sweep the excess aggregate on the edge of each pass which will be in contact with the next pass so that there will be no build up of aggregate at the seams or joints between passes. The broomed aggregate shall be swept onto the freshly laid course.

4.6.4 BITUMINOUS CHIP SEAL CONSTRUCTION METHODS. The methods employed in installing bituminous chip seal(s) shall include, but are not limited to, the following:

4.6.4.1 SURFACE PREPARATION. All dust, dirt, tracked on clay and foreign material shall be removed from the surfaces to be sealed by sweeping the surface with power brooms, hand brooms, power blowers, or by flushing it with water or a combination of the above. All patching, crack filling and drainage improvements required by the County's Representative shall be completed prior to the commencement of the surface treatment application. After the cleaning operation has been completed, and prior to the application of the surface treatment, the area to be treated will be inspected by the County's Representative to determine its fitness for receiving the surface treatment.

All sewer manhole lids, water valve covers and survey monument covers shall be protected from the application of the seal coat by placing building paper over the lids (cut to the exact dimensions of the lids) prior to the application of the seal coat. At the completion of the sealing operations, all protective coverings shall be removed from said survey monument covers, manhole lids and valve covers.

At the edges of all passes which will form longitudinal joints in the surface treatment (chip seal) the edge of the pass shall be swept clean of all chips for a distance of from four to six (4-6) inches back from the edge prior to the application of the adjacent pass to allow for overlap without chip buildup (humps) in the previous pass. Building paper shall be laid on all cross gutters (concrete waterways) to prevent the chip seal from being applied to said gutters. The Contractor shall place building paper at the beginning of all chip passes. Immediately after the chip application, the building paper shall be removed and properly disposed of.

4.6.4.2 ASPHALT APPLICATION. Application of the bituminous material shall not be permitted until the loaded aggregate trucks, rollers, and chip-spreader are in place and ready to apply, and roll, the cover aggregate. No surface will be chip sealed until authorization to do so has been obtained from the County's Representative. The asphalt material shall be applied at

0.32 to 0.40 gallons per square yard or as determined by the County's Representative and at a temperature between 125 degrees and 185 degrees Fahrenheit. The exact temperature used to apply the bituminous material shall be determined according to the supplier's recommendations.

The bituminous material shall be applied by an asphalt distributor, as described above, so that uniform distribution in the quantities specified is obtained over all points of the surface to be treated. All lightly-coated areas and spots missed by the distributor shall be properly treated with bituminous material applied by hand. No more asphalt shall be applied than can be covered with aggregate in sixty (60) seconds or less. Distances between the distributer and chip-spreader shall be as close as possible, but in no case shall the chip-spreader be greater than fifty (50) feet behind the distributer during the chipping operations.

4.6.4.3 AGGREGATE SPREADING. Immediately following the application of the bituminous material, the aggregate shall be evenly spread over the surface at a uniform quantity of twenty-five to thirty (25-30) pounds per square yard of surface area. Upon commencement of the work, and during its progress, the individual quantities of bitumen and aggregate may be varied to meet specific field conditions. An adequate supply of aggregate shall be available on the job site to permit continual spreading operations. Aggregate shall be damp (not wet) prior to being spread on the surface. The aggregate shall be spread by using a self-propelled spreader machine (Flarity or equal). The aggregate shall be spread evenly by hand on all areas missed by the aggregate spreader. Back-spotting or sprinkling of additional aggregate over the areas having insufficient cover shall be done by hand and shall be continued during the operations whenever necessary.

As the distributor moves forward to spray the asphalt, the aggregate spreader shall start right behind it, spreading the damp chips uniformly and at the specified rate. The asphalt distributor shall travel at the same rate of speed as the chip spreader and in no case shall the two machines be separated by more than fifty (50) feet during the sealing process. Operating the chip spreader at speeds which cause the chips to roll over after striking the bituminous-covered surface will not be permitted.

Excess aggregate deposited in localized areas shall be immediately removed, and in areas where application is insufficient, additional aggregate shall be added by hand prior to the time the asphalt "breaks".

4.6.4.4 AGGREGATE COMPACTION. The treated surface shall be rolled with rubber-tired rollers immediately after the distribution of the cover aggregate, and rolling shall continue until the aggregate is properly seated in the binder. Rollers shall proceed in the longitudinal direction, working across the treated surface until the entire width and length of the treated surface has been rolled at least four (4) times. All rolling shall be completed

within one (1) hour after the application of the cover aggregate. Rollers and gravel trucks shall not be operated at speeds great enough to kick up chips, and in no case shall rollers be operated above ten (10) miles per hour. In all places not accessible to the rollers, the aggregate shall be adequately compacted with pneumatic type hand tampers. Any aggregate that becomes coated, or mixed with dirt or any other foreign material shall be removed, replaced with clean aggregate over a newly-sprayed surface, and then re-rolled as directed by the County's Representative.

Bituminous material and chips shall not be spread more than one hundred (100) feet ahead of completion of initial rolling operations.

No aggregate will be allowed to be swept into the gutters, onto the sidewalks, or thrown onto private property. The Contractor shall be responsible for the cleanup of any and all aggregate swept into these areas.

Prior to placing the second chip seal course on streets designated for double chip seals, the first course shall be thoroughly rolled to set the chips, then no less than 24 hours later the excess chips shall be removed. Upon removal of the excess chips, the second course may be applied.

4.6.4.5. LOOSE AGGREGATE REMOVAL. Upon completion of rolling, traffic will be allowed to use the streets at a speed not to exceed fifteen (15) miles per hour for a period of not less than twenty four (24) hours. Safety and warning signs as per MUTCD shall be provided to slow traffic and warn of loose gravel. After the chips are set in the bituminous binder, but not earlier than the following day, or as directed by County's Representative, loose chips on the surface of the road shall be broomed and removed in such a manner that the aggregate set in the binder will not be displaced. Excessive brooming will not be permitted. At the end of seven (7) days, any excess chips shall be removed in such a manner that the aggregate set in the binder will not be displaced. Excessive rolling or brooming will not be permitted.

4.6.4.6. SANDING. After the surface has been opened to traffic, any excess bituminous material that comes to the surface (bleeds) shall be immediately covered with clean sand. The Contractor shall be required to have sufficient <u>clean</u> sand (not dirt) on hand or available to immediately sand any bleeding spots when requested by the County's Representative. Sanding shall be accomplished by evenly spreading the sand over the affected area and then hand brooming the sand to a smooth even surface with no bumps, ruts, depressions or irregularities visible.

4.6.4.7. APPEARANCE. The completed chip sealed surface shall present a uniform appearance and shall be thoroughly rolled and compacted and free from ruts, humps, depressions or irregularities due to an uneven distribution of bituminous binder or aggregate. In the event the surface presents an

unacceptable appearance, as determined by the County's Representative, the Contractor shall repair unacceptable areas in accordance with the County Representative's directions.

4.6.4.8. WEATHER LIMITATIONS. Chip seal treatments shall be placed only when the air temperature in the shade is above 75 degrees Fahrenheit. The chip seal shall not be placed when the temperature of the road surface is below 70 degrees Fahrenheit, above 120 degrees Fahrenheit, during rainy weather, when the surface is wet or during other unfavorable weather conditions as determined by the County's Representative.

4.7 ASPHALT EMULSION SEAL COAT (SLURRY SEAL). This sub-section covers the requirements for the application of slurry seal coats on existing road surfaces. The slurry seal surface treatment shall consist of a mixture of emulsified asphalt, mineral aggregate, mineral filler, set control additive, and water. The slurry shall be properly proportioned, mixed, and spread evenly on a prepared surface in accordance with these specifications, or as directed by the County's Representative. When cured, the slurry shall have a homogeneous appearance, fill all cracks, adhere firmly to the road surface, and have a skid resistant texture.

4.7.1 MATERIAL SPECIFICATIONS.

4.7.1.1. ASPHALT EMULSION. The asphalt emulsion shall conform to the specifications outlined in Tables 4.21, 4.22 and 4.23. Either cationic or anionic emulsion may be used, whichever is best suited to the aggregate and job conditions to be encountered, as determined by compatibility tests and procedures as specified in the latest edition of the ISSA Technical Bulletin #115.

4.7.1.2. AGGREGATE. The mineral aggregate shall consist of angular sand, or crushed stone, that is free from dirt, organic matter, clay balls, adherent films of clay, dust or other objectionable matter. When tested according to AASHTO T-176, the aggregate shall have a sand equivalent of not less than forty five (45), and the aggregate shall be non-plastic. When tested according to AASHTO T-104, the aggregate shall show a loss of not more than fifteen (15) percent, and when tested according to AASHTO T-96, the aggregate shall show a loss of not more than thirty five (35) percent.

The combined mineral aggregate shall conform to the requirements of type II or type III slurry as outlined in Table 4.24.

4.7.1.3. FILLER. The mineral filler shall conform to the requirements of AASHTO M-16 and shall be used to improve the gradation of the aggregate, to provide improved stability and workability of the slurry, and to increase the durability of the cured slurry.

4.7.1.4. SET CONTROL ADDITIVE. To control the setting time of the slurry mixture, an additive shall be added which will retard the set when a cationic emulsion is used, or accelerate the set when an anionic emulsion is used. The set control additive shall be aluminum sulfate or Portland Cement Type I/II, and shall be added to the slurry mix by an approved method that will assure uniform distribution and proper control. The exact amount shall be determined by previous testing and conditions in the field.

TABLE 4.21
SLURRY SEAL TEST SPECIFICATIONS
TESTS OF EMULSIONS

TESTS	TEST METHOD	TYPE OF EMULSION	
	ASTM	ANIONIC	CATIONIC
		Quick Setting	Quick Setting
		QS-1H	CQS-1H CQS-1H-LM
Particle Charge Test	D244	Negative	Positive
Viscosity, 60 ml., @ 77^0 F., 5 seconds	D244	15 min. to 100 max.	
Residue by distillation	D244	60 percent by weight, minimum	
Settlement After Five Days (%)	D244	5 percent maximum	
Sieve Test Wt., (%)	D244	0.10 maximum	
Cement Mixing Test	D244, 32-36	2 % Maximum	Not Applicable

TABLE 4.22
SLURRY SEAL TEST SPECIFICATIONS
TESTS OF RESIDUE

TESTS	TEST METHOD	TYPE OF EMULSION	
	ASTM	ANIONIC	CATIONIC
		Quick Setting	Quick Setting
		QS-1H	CQS-1H CQS-1H-LM
Penetration 100 gm. @ 77^0 F for 5 seconds	D244	40 to 90 mm	40 to 90 mm
Solubility in Trichloroethylne	D2042 4d	97.5 percent, minimum	
Ductility, 5 cm/mm @	D244	40 cm., minimum	

TABLE 4.23
SLURRY SEAL TEST SPECIFICATIONS
TESTS ON SLURRY SEAL JOB MIXTURE

TESTS	TEST METHOD		TYPE OF EMULSION	
	AASHTO	ASTM	ANIONIC	CATIONIC
			Quick Setting	Quick Setting
			QS-1H	CQS-1H CQS-1H-LM
Mixing Time @ 77^0 F (ISSA TB #102)	---	---	120 seconds minimum	120 seconds minimum
Set Time Tests (30 minutes) Blotter Test (ISSA TB #102)	---	---	No Brown Stain	No Brown Stain
Displacement Test	---	---	No Displacement	No Displacement
Water Resistance Test @ 30 Min. (ISSA TB #102)	---	---	No Discoloration	No Discoloration
Wet Stripping Test, Coating (ISSA TB #114)	---	---	90 percent, minimum	
System Compatibility	C	C	Compatible	

TABLE 4.24
SLURRY MIXTURE GRADATION

Type of Slurry	II	III
General Usage	General seal, medium textured surfaces; second course slurry	First and/or second application of two-course slurry; highly textured surfaces
Sieve Size (USA Standard Series)	PERCENT PASSING	
3/8 inch	100	100
No. 4	90-100	70-90
No. 8	65-90	45-70
No. 16	45-70	28-50
No. 30	30-50	19-34
No. 50	18-30	12-25
No. 100	10-21	7-18
No. 200	5-15	5-15

4.7.1.5. WATER. Water for the slurry mixture shall be potable and free from harmful soluble salts.

4.7.2 MATERIAL QUALITY CONTROL.

4.7.2.1. SAMPLING AND TESTING. Prior to the commencement of sealing operations, sources of all materials shall be selected and tested in accordance with the appropriate test requirements. Additional tests may be required by the County's Representative during the progress of the work. A test section shall be placed as per Section 4.7.4.6.

4.7.2.2. JOB MIX DESIGN. No slurry mixture shall be placed until a mix design submitted by the Contractor has been approved by the County's Representative. The exact proportions of asphalt emulsion, aggregate, mineral filler, and water to be used in the preparation of the slurry seal shall be determined by an approved testing laboratory experienced in slurry mix design procedures.

The residual asphalt content of the mix shall be from 7.5 to 13.5 percent of

the dry aggregate for type II slurry seal or 6.5 to 12 percent of the dry aggregate for type III slurry seal.

The slurry shall be a homogeneous mixture, sufficiently stable during the entire mixing-spreading period so that the emulsion will not "break". There shall be no segregation of the fines from the coarser aggregate, and the liquid portion of the mix shall not float to the surface. If it is established that a satisfactory mixture meeting the requirements specified herein cannot be produced from the materials furnished, the materials shall be rejected and the Contractor shall submit new samples.

The wet track abrasion test shall not exceed a maximum wear loss of seventy five (75) grams per square foot.

4.7.3 EQUIPMENT. The equipment, tools, and machines required for the performance of the work shall be subject to the approval of the County's Representative and shall be maintained in a satisfactory working condition at all times.

4.7.3.1. SLURRY MIXING MACHINE. The slurry mixing machine shall be a continuous flow mixing unit, capable of delivering accurately predetermined proportions of aggregate, water and asphalt emulsion to a revolving spiraled multi-blade mixer tank, and of discharging the thoroughly-mixed product on a continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit shall be capable of thoroughly blending all ingredients together without violent action. The mixing machine shall be equipped with an approved fines feeder with an accurate metering device or method of introducing a predetermined proportion of mineral filler into the mixer as the aggregate is fed into the mixer. The fines feeder shall be used when mineral filler is part of the aggregate blend. The mixing machine shall be equipped with a water pressure system and fog-type spray-bar adequate for completely fogging the surface to be sealed with up to 0.05 gallons of water per square yard, immediately ahead of the spreading equipment. The machine shall be capable of mixing materials at pre-set proportions regardless of the speed of the machine and without changing machine settings.

4.7.3.2. SLURRY SPREADER. Attached to the mixing machine shall be a mechanical-type squeegee distributor, having a rubber-like material in contact with the surface to be sealed to prevent unwanted egress of slurry. An appropriate mechanical device for lateral distribution of the slurry shall be operated within the spreader box. There shall also be a steering device and a flexible strike-off. The spreader box shall be adjustable to various widths from eight (8) to twelve (12) feet. The box shall be kept clean with no extensive build-up of asphalt and aggregate on the box. A burlap drag of at least one (1) foot in width shall be attached to the back of the spreader box to smooth out irregularities in the slurry surface.

4.7.3.3. SURFACE CLEANING EQUIPMENT. Power brooms, power blowers, vacuums, air compressors, water flushing equipment, and hand brooms suitable for cleaning the road surface and cracks therein may be used for surface cleaning.

4.7.3.4. AUXILIARY EQUIPMENT. Hand squeegees, burlap mops, shovels and other equipment shall be provided as necessary to perform the work.

4.7.4 ASPHALT EMULSION SLURRY CONSTRUCTION METHODS.

4.7.4.1. RESIDENT NOTIFICATION. The Contractor shall be responsible for notifying all affected residents of pending cleaning and/or sealing operations on streets abutting their properties. Notification shall be no more than forty eight (48) hours, nor less than twenty four (24) hours, in advance of said cleaning/sealing operations. If there should be any change in scheduling for a particular days production, the Contractor shall be required to notify all of the residents affected by the schedule change no later than one (1) hour after the schedule change has been determined.

4.7.4.2. VEHICLE REMOVAL. The Contractor shall be responsible for the removal of all vehicles from the streets to be cleaned, and shall endeavor to notify the owners of the vehicles to move them prior to his cleaning operations. In the event owners of said vehicles cannot be located, the Contractor shall have them towed from the construction zone prior to cleaning and shall be responsible for all costs incurred for said towing.

4.7.4.3. PREPARATION OF SURFACE. In the event that patching or surface smoothing is required to prepare the street surface for the slurry seal, the Contractor shall patch the street surface with hot mix asphalt prior to the application of the slurry sealing. Prior to the application of the slurry seal, the County's Representative shall give approval that the surfaces have been properly prepared. No slurry seal material will be laid without the County Representative's approval.

4.7.4.4. CLEANING STREETS. Prior to the commencement of Slurry Seal operations, the Contractor shall thoroughly clean and remove all mud spots and loose or objectionable material from the existing pavement surface. Any standard cleaning method will be acceptable, except that water flushing will not be permitted in areas where poor drainage conditions on the road or at the sides of the road are present, as determined by the County's Representative.

Traffic paint on the surface to be treated that is not tightly bonded to the surface shall be removed.

Areas impregnated with grease, oil, or fuel shall be scrubbed with industrial-type detergent and flushed thoroughly to remove all traces of detergent and oil.

After the cleaning operations have been completed, and prior to the application of the surface treatment, the area to be treated will be inspected by the County's Representative to determine it's fitness for receiving the surface treatment. No surface shall be slurry sealed until authorization to do so has been obtained from the County's Representative.

4.7.4.5. SEWER MANHOLE LIDS AND WATER VALVE COVERS. Prior to the application of the seal coat, all sewer manhole lids, survey monument lids, storm drain manhole lids and water valve covers shall be protected from the application of the slurry seal coat by placing building paper over the lids (cut to the exact dimensions of the frames so as to prevent the slurry seal from entering into the seam between the frame and lid). At the completion of the sealing operations, the Contractor shall remove all building paper protectors placed on said lids and covers.

4.7.4.6. TEST SECTION. Prior to full production, the Contractor shall place a test section of at least sixty (60) square yards in an area designated by the County's Representative. The test section shall be placed using the same equipment, methods, and mix as will be used on the job.

If the test section should prove to be unsatisfactory, necessary adjustments to the mix design, equipment, and/or placement methods shall be made. Additional test sections, as required, shall be placed and evaluated for compliance with the specifications. If the test section does not conform to the specification requirements, the defective slurry seal shall be removed. Full production shall not begin without approval of the County's representative.

4.7.4.7. WATER FOG. Immediately prior to application of the slurry seal, the surface of the pavement shall be moistened with a fog spray of water, applied at the rate of 0.02 to 0.05 gallon per square yard from the spray bar attached to the slurry seal machine. No free water shall pond on the surface of the pavement following the fog spray. The rate of application of the fog spray shall be adjusted during the day to suit pavement temperatures, surface texture, humidity, and dryness of the pavement surface.

4.7.4.8. PREPARATION OF SLURRY. The slurry seal shall be mixed and applied with a slurry machine as outlined below. The amount and type of asphalt emulsion to be blended with aggregate shall be determined by the laboratory mix design. A minimum amount of watershall be used as necessary, to obtain a workable and homogeneous mixture. The slurry

mixture shall be of proper consistency with no segregation when deposited on the surface of the pavement and no additional elements shall be added. The slurry mixture shall show no signs of uncoated aggregate or premature breaking of emulsion, when applied to the pavement surface. Total time of mixing shall not exceed four (4) minutes.

4.7.4.9. APPLICATION OF SLURRY. Sufficient quantities of the slurry seal mixture shall be fed into the spreader box such that a uniform and complete coverage of the pavement is obtained. The slurry seal machine shall be operated at such a speed that the amount of slurry in the spreader box shall remain essentially constant. The slurry seal shall be placed at a rate within the following general limits: Type II slurry - 10-15 #/yd.^{2}; Type III slurry - 15-20 #/yd.^{2}. The finished slurry thickness shall not be less than 3/8 of an inch. No build-up of the cured slurry seal mix shall be allowed to collect in the spreader box. No streaks caused by oversized aggregate particles, or build-up of slurry mix on squeegees, shall be left on the finished surface.

If a uniform thickness cannot be met with one application due to irregularities in the pavement surface, multiple applications shall be made. Where multiple applications are required, as determined by the County's Representative, each application shall be thoroughly cured prior to the application of the subsequent courses.

4.7.4.10. HANDWORK. Approved squeegees and mops shall be used to spread slurry in areas not accessible to the slurry spreader box. Care shall be exercised in leaving no unsightly appearance from handwork. When doing handwork in small areas, especially fill-in behind the slurry machine, the material shall be spread and mopped in the direction of the machine pass.

4.7.4.11. JOINTS. The longitudinal joints between adjacent lanes shall have no visible lap, pinholes, or uncovered areas. Thick spots caused by overlapping shall be smoothed immediately with hand squeegees before the emulsion breaks. Overlaps which occur at transverse joints shall also be smoothed before the emulsion breaks, so that a uniform surface is obtained which contains no breaks or discontinuities.

4.7.4.12. CURING. Treated areas shall be allowed to cure until the treated pavement will not be damaged by traffic. The Contractor shall protect this area for the full curing period with suitable barricades or markers.

Areas which are damaged before being opened to traffic shall be repaired by the Contractor.

4.7.4.13. WEATHER LIMITATIONS. The slurry seal shall not be applied when either atmospheric or pavement temperature is below 55 degrees, or

above 100 degrees Fahrenheit, when raining or during periods of abnormally high relative humidity, or as determined by the County's Representative.

4.7.5 FOG COAT. If required, a fog seal coat of asphalt mixture shall be applied to the finished pavement surface within five (5) days after the bituminous surface course has been placed.

4.7.5.1. EQUIPMENT. The fog seal shall be applied with a standard bituminous distributor. All spread bar tips shall be clean and free from burrs, and shall be adjustable for regulated flow.

4.7.5.2. MATERIAL. The material required for fog sealing shall be a blend of specially selected acrylic co-polymer and asphalt. The material shall be formulated to provide the following characteristics:

1. The material shall contain 15% (by weight) acrylic polymer solids and 85% (by weight) asphalt solids

2. The viscosity of the blended material (by Zahn method) shall be from 35 to 100 SSF.

3. The pH of the material shall be from 8 to 10, and the colloidal charge shall be anionic.

4. The elongation of a standard specimen at break shall be no less than 400% at 32°F, and no less than 700% at 77°F.

5. The durability of the material shall show no signs of cracking, checking, blistering, or peeling after a minimum of 165 hours of exposure to ultraviolet heat, and water cycles in the Weather-o-meter.

6. "Peel Strength" of the material shall be a minimum of four (4) pounds per inch after exposure to 165 hours in the Weather-o-meter.

4.7.5.3. APPLICATION. The material shall be diluted with two (2) gallons of material to one (1) gallon of water. Coverage shall be a one-coat application of 0.08 to 0.12 gallons per square yard, depending on the porosity of the surface as determined by the County Representative. The material shall not be applied to surfaces which are dirty or dusty. Ideal application temperature for the material shall be 150°F. the application temperatures may range from 120°F to 160°F, but in no case shall the material be heated above 170°F.

4.7.5.4. WEATHER LIMITATIONS. The material shall not be applied to

wet pavement surfaces or during rainy or damp weather, or when rain is anticipated within eight hours after application is completed. The material shall not be applied on extremely windy days. The material shall be protected from freezing, and shall not be subjected to prolonged periods of outside temperatures below 40°F.

4.7.5.5. CURE TIME. Under ideal weather conditions, cure time for the material shall be from four (4) to six (6) hours, however, all traffic shall be kept off the road until the surface is no longer tacky and the material does not track or come off when stepped on.

4.7.5.6. PREPARATION OF PAVEMENT SURFACES. Prior to commencement of the fog seal application, the pavement surface will be thoroughly cleaned, after which the area to be treated will be inspected by the County Representative.

4.7.5.7. SANDING. Where unavoidable traffic or construction activities may cause tracking of the fog seal material, the contractor shall sand the surface after it has been fog sealed. Any damage to the traveling public resulting from sealant application, or sealant tracking, shall be paid for by the contractor.

4.8 CONCRETE WORK. This section defines the materials to be used and the requirements for mixing, placing, finishing and curing all Portland cement concrete work.

4.8.1. MATERIALS. Concrete materials shall conform to the following requirements.

4.8.1.1 PORTLAND CEMENT CONCRETE MATERIAL. Concrete shall be composed of coarse aggregate, fine aggregate, Portland Cement and water, air entrainment and admixtures and shall conform to the requirements of this section. A concrete mix design shall be prepared by the supplier, certified by an independent testing lab and submitted to the County for review and approval prior to concrete being used in County projects.

A. **PORTLAND CEMENT.** ANSI/ASTM C 150, Type V, shall be used unless otherwise indicated, or approved by the County representative. Only one brand of cement shall be used throughout a project, unless otherwise approved by County's Representative. Certified copies of the mill test for the cement shall be furnished upon request of the County's Representative.

B. **AGGREGATE.** Except as otherwise specified herein, concrete aggregate shall conform to all applicable provisions of the latest revision of ASTM Standard Specification C 33.

B.1 **Fine Aggregate**. Fine aggregate shall consist of natural sand

having clean, hard, durable, uncoated grains and shall conform to the requirements of these standards. Other inert materials with similar characteristics shall not be used unless approved by the County representative. The amount of deleterious substances shall not exceed the following limits.

TABLE 4.25
FINE AGGREGATE

MATERIAL	PERCENT (by weight)
Clay Lumps	1.00
Coal and lignite	0.50
Material passing No. 200 sieve	3.00
Other deleterious substances such as shale, alkali, mica, coated grains, soft and flaky particles, etc.	3.00
Gypsum	1.00

The combined sum of the percentage of all deleterious substances in fine aggregate listed above shall not exceed three (3) percent by weight.

Fine aggregate shall be well graded and shall range in size from fine to coarse within the following percentages by weight:

TABLE 4.26
FINE AGGREGATE GRADATION REQUIREMENTS

SIEVE SIZE	PERCENT PASSING (by weight)
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

B.2 **Coarse Aggregate**. Coarse aggregate shall consist of crushed or natural stone, gravel, slag or other approved inert material with similar characteristics or combination thereof, having clean, hard, durable, uncoated particles free from deleterious matter. Deleterious substances shall not be present in the aggregate in excess of the following limits:

TABLE 4.27
COARSE AGGREGATE

MATERIAL	PERCENT (by weight)
Soft fragments	2.00
Coal and lignite	0.30
Clay Lumps	0.25
Material passing No. 200 sieve	1.00
Other deleterious substances such as shale, alkali, mica, coated grains, soft and flaky particles, etc.	3.00
Gypsum	1.00

The combined sum of the percentages of deleterious substances (in both course and fine aggregate), shall not exceed five (5) percent, by weight.

Coarse aggregate shall be rejected if it fails to meet the following test requirements:

a. Los Angeles Abrasion Test. If the percent of loss by weight exceeds ten (10) percent at one hundred (100) revolutions, or forty (40) percent at five hundred (500) revolutions.

b. Sodium Sulfate Test for Soundness. If the weighted average loss after five (5) cycles is more than twelve (12) percent by weight.

c. Gradation. Coarse aggregate shall be graded by weights as follows:

TABLE 4.28
COARSE AGGREGATE GRADATION REQUIREMENTS

SIEVE SIZE	PERCENT PASSING (by weight)
1 inch	100
3/4 inch	90-100
3/8 inch	20-55
No. 4	0-10
No. 8	0-5

d. Aggregate Size. The maximum size of the aggregate shall not be larger than one fifth (1/5th) of the narrowest dimension between forms within which the concrete is to be encased, and in no case larger than three-fourths (3/4ths) of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms. For non-reinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth (1/4th) the slab thickness.

C. **WATER.** Sufficient potable water shall be added to the mix to produce concrete with the minimum practical slump. The slump shall not be greater than four (4) inches. However, a higher slump may be allowed with plasticizers, providing there is no loss of strength or durability and prior approval for use is obtained from the County's Representative.

The maximum permissible water-cement ratio (including free moisture in the aggregate) shall be five (5) gallons per bag of cement (0.44) for Class A and five and three-quarter (5 ¾) gallons per bag of cement (0.51) for Class C concrete.

D. **ENTRAINING AGENT.** An air-entraining agent shall be used in all concrete exposed to the weather. The agent shall conform to ASTM designation C 260. Air content for air-entrained concrete shall be five (5) percent by volume (plus or minus one (1) percent). The air-entraining agent shall be added as a liquid to the mixing water by means of mechanical equipment capable of accurate measurement and control.

E. **ADMIXTURES.**

E.1 Pozzolan. When authorized by the County Representative, pozzolan conforming to the requirements of ASTM C 618 Class F may be added to the concrete mix as outlined below:

1. Pozzolan may be used as a replacement to the required Portland Cement content provided no other supplemental specification prevents its use. The maximum percentage of Portland Cement replacement on a weight basis is 15 percent.

2. Pozzolan/cement replacement ratio is 1.25 to 1 (pozzolan/cement).

3. Water/cement ratio is established before Portland Cement is replaced with pozzolan.

4. Loss of ignition of pozzolan is less than 1 percent.

5. Trial batches for each aggregate source and concrete class have been run for each mix design.

6. All other requirements and references to testing procedures and specifications of Section 4.8 ”Concrete Work“ shall apply.

Pozzolan shall be sampled and tested as prescribed in ASTM C 618 and ASTM C 311. The Concrete Supplier shall obtain and deliver to the County’s Representative a certification of compliance signed by the pozzolan supplier identifying the pozzolan and stating that the pozzolan delivered to the batching site complies with applicable specifications.

Pozzolan material shall be handled and stored in the same manner as Portland Cement. When facilities for handling bulk pozzolan are not available, the pozzolan shall be delivered in original unopened sacks bearing the name and brand of supplier, the type and source of the pozzolan, and the weight contained in each sack plainly marked thereon.

Different brands or types of pozzolan shall not be mixed together unless written permission has first been obtained from the County Representative. All pozzolan used in the manufacture of concrete for any individual structure shall be of the same type, and from the same source unless otherwise approved by the County’s Representative.

COMPLIANCE ANALYSIS: During the course of concrete testing,

the County may require, at random, additional concrete cylinders for the purpose of performing a "Petrographic Examination" in accordance with ASTM C 856.

The "Petrographic Examination" may be initiated when compressive strength tests show inconsistencies, when batch tickets show indications that material is batched which is not in accordance with approved mix designs, or when there are other indicators that the concrete may not meet Standards.

The "Petrographic Examination" will be performed by a Certified Testing Laboratory qualified to perform such testing

E.2 **Calcium Chloride**. Calcium Chloride shall not be added to any concrete mix. Non-chloride accelerators may be used upon approval of the County Representative.

E.3 **Water Reducing Agents**. Both regular and high range water reducing agents (super-plasticizers) complying with ASTM Specification C 494, Types "A" (water reducing), "D" (water reducing and retarding), "F" (water reducing high range), and "G" (water reducing, high range, and retarding) may be added to the concrete to improve its workability and to reduce the water/cement ratio. The amount of water reducing agent added shall be no greater than 1.5 pounds per cubic yard of concrete. Maximum concrete slump with Types "A" and "D" shall be four (4) inches. Maximum concrete slump with Types "F" and "G" shall be seven (7) inches.

F. **CONCRETE MIX.** For the purpose of practical identification, concrete has been divided into classes. The basic requirements of class A and class C and the use for each are defined in Table 4.29.

F.1 **Submittals.** The following information must be included with all concrete mix designs submitted for review and approval by the County as per subsection 4.8.1.1 "Portland Cement Concrete Material".

A. Test results on coarse and fine aggregates to verify compliance with applicable specifications.

B. Trial batch test results and past history test information on proposed mix designs, which support compliance with the requirements for compressive strength, durability, etc. Performance curves used to verify 28 day strength must be submitted with trial batch tests or history information.

C. Certification of compliance from the cement supplier, the pozzolan supplier, and the air-entraining agent supplier, stating that the material being delivered are in compliance with applicable specifications

D. All mix designs shall be certified by a Certified Testing Laboratory.

G. **BATCH PLANT TICKET.** All concrete produced and delivered to a job site within Washington County, will be accompanied by a batch plant ticket. The ticket will state the time manufactured or batched and accurately show all components used for that particular load or batch. Sufficient copies shall be provided for testing personnel and Washington County representatives, if requested.

TABLE 4.29
CONCRETE MIX SPECIFICATIONS

Class	Minimum Cement Content		Maximum Water Content** (gal./bag of cement)	Maximum Slump	Minimum 28-day Comp. Strength (psi)	Primary Use
	(Bags/ C.Y.)	(pounds/ C.Y.)				
A	6	564	5	4" 1 1/2"*	4000	Reinforced structural concrete; sidewalks; curbs & gutters; cross gutters; pavements; unreinforced footings
C	5	470	5.75	4"	3000	Minor non-structural items such as thrust blocks; anchors, mass concrete, etc.

* For machine placement only.
** Including free moisture in aggregate.

NOTE: Unless otherwise specifically designated by the County representative all

concrete placed shall be Class "A", six-bag mix, with a minimum allowable compressive strength of 4000 p.s.i at the age of twenty eight (28) days.

4.8.1.2 CONCRETE REINFORCING MATERIALS. Concrete reinforcing materials shall conform to the following requirements.

A. **STEEL BARS.** All bar material used for reinforcement of concrete shall be hard grade deformed round steel conforming to the requirements of ASTM Designation A 615. All reinforcing steel shall be minimum grade sixty (60) unless approved otherwise by the County representative. All bars shall be deformed, round and have a net section equivalent to that of plain bar of equal nominal size. Only hard grades will be used. Twisted bars will not be accepted.

All rebar shall be clearly marked with identifying markings in accordance with industry standards.

All reinforcing steel, at the time concrete is placed, shall be free from flaws, cracks, rust, oil, dirt, paint, or other coatings that will destroy or reduce the bond.

B. **WIRE OR WIRE FABRIC REINFORCEMENT.** Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM A 185. Wire for concrete reinforcement shall conform to the requirements of the "Standard Specification for Cold Drawn Steel Wire for Concrete Reinforcement" ASTM A-82. All wire reinforcement, wire fabric, or expanded metal shall be of the type designated unless an alternate type is approved by the County representative.

C. **STEEL FIBER REINFORCEMENT.** Deformed steel fiber for concrete reinforcement shall conform to the requirements of ASTM A-820, type I, deformed fiber, except that the average tensile strength shall be not less than 150,000 psi.

D. **SYNTHETIC REINFORCING FIBERS.** Engineered synthetic reinforcing fibers shall be 100% polypropylene collated, fibrillated fibers. Fiber length, and amount per manufacturer's recommendations shall correspond with the concrete mixture (generally 1.5 pounds per cubic yard of concrete). Physical property of the fibers shall be as follows:

TABLE 4.30
SYNTHETIC REINFORCING FIBERS

Specific Gravity	0.91
Modulus of elasticity	500,000 to 700,000 psi
Tensile strength	70,000 to 110,000 psi
Length	0.25 to 2.50 inches

The fiber manufacturer shall certify that all polypropylene fibers meet the physical properties, and are specifically manufactured for use in concrete from virgin polypropylene, containing no reprocessed olefin materials. If the fiber manufacturer is other than the brand name listed on the literature and packaging, the certification must be from the original manufacturer of the fibers.

Fiber-mesh shall be added only at the concrete batch plant to assure uniform and complete dispersion of the collated-fibrillated fiber bundles into single mono-filaments within the concrete.

4.8.1.3 CURB, GUTTER, SIDEWALK AND BASE MATERIALS. Concrete and base materials shall conform to the following requirements.

A. **GENERAL.** This subsection defines materials, practices and designs to be used in the construction of all curb, gutter and sidewalk.

All curb, gutter and sidewalk shall consist of air-entrained Type V Portland Cement Concrete and shall be constructed on a prepared subgrade in accordance with these specifications. All work shall conform to the lines and grades, thickness, and typical cross sections shown on the approved plans or established by the County's Representative.

B. **SUBGRADE.** The subgrade shall be excavated and filled with suitable material, as specified in Section 4.3.2.3 of these standards. All soft, yielding and otherwise unsuitable material shall be removed and replaced with suitable materials as outlined above. Filled sections shall be compacted and extend to a minimum of one (1) foot outside the form lines according to Section 4.3.2.3 of these standards.

C. **GRAVEL BASE COURSE.** A gravel base course consisting of crushed road base gravel shall be placed under all curbs, gutters, driveways, waterways, sidewalks and other miscellaneous flatwork. The gravel base material shall conform to the requirements contained in Section 4.5.7 of these specifications. Where the foundation material is found to be unstable, the Contractor shall furnish and place sufficient

additional gravel or other suitable material as directed by the County's Representative to provide an adequate foundation upon which the concrete will be placed.

4.8.2. CONSTRUCTION METHODS AND EQUIPMENT. The methods employed in performing and executing the work shall be the responsibility of the Contractor.

4.8.2.1 GENERAL CONCRETE PLACEMENT. Generally, concrete shall be placed as follows:

A. **FORMS.** Forms shall be properly built and adequately braced to withstand the liquid weight of concrete being placed in the forms. All linings, studding, whaling and bracing shall be such as to prevent bulging, spreading, loss of true alignment or displacement while placing and during setting of concrete.

B. **PREPARATIONS.** Prior to batching and placing concrete, all equipment for mixing and transporting the concrete shall be cleaned. All debris, ponding water, and ice shall be removed from the areas to be occupied by the concrete. All forms shall be oiled with a form-release agent. Masonry support or filler units that will be in contact with concrete shall be well drenched with water (except in freezing weather). Reinforcement (rebar or wire mesh) shall be thoroughly cleaned. Reinforcement that has become too hot, due to sun exposure, in the opinion of the County Representative, will be cooled with water prior to concrete being placed.

When placing concrete on earth surfaces, the surfaces shall be free from frost, ice, mud, water and other deleterious materials. When the subgrade is dry or pervious, it shall be sprayed with water prior to the placing of concrete. No concrete shall be placed until the preparatory work (i.e. forms, reinforcement, etc) has been inspected and approved by the County's Representative.

C. **CONCRETE MIXING AND DELIVERY.** The concrete shall be mixed until there is a uniform distribution of the materials. Sufficient water shall be used in concrete in which reinforcement is to be imbedded, to produce a mixture which will flow sluggishly when worked and can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In no case shall the quantity of water used be sufficient to cause the collection of a surplus in the forms.

Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in Specifications for Ready-mixed Concrete (ASTM C-94). Concrete shall be delivered and deposited in its final position within ninety (90) minutes after the cement and water have been

added to the mixture.

D. **DEPOSITING.** Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Concrete placement shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the corners of forms and around reinforcing bars. Concrete that has partially hardened or is contaminated by foreign material shall not be deposited in the work. Re-tempered concrete shall not be used.

Temperature of the mixed concrete shall be maintained between 60°F and 90°F at time of placement.

All concrete in structures shall be compacted by means of high-frequency internal vibrators of approved type and design during the operation of placing, and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms. Care must be taken not to overuse vibrators causing separation of cement and aggregates.

E. **FINISHING.** After the concrete for slabs has been brought to the established grade and screeded, it shall be worked with a float and then given a light "broom" finish. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or hasten hardening. Surface edges of all slabs shall be rounded to a radius of one quarter (1/4) to one half (1/2) inch with standard concrete finishing tools. Additional water shall not be sprinkled on the surface to aid finishing.

F. **CURING AND PROTECTION.** As soon as the concrete has hardened sufficiently, it shall be protected and cured in accordance with ACI Standards. The finished surface shall be kept moist for a minimum of seven days, or a chemical curing agent used to prevent the concrete from premature drying.

The freshly finished surface shall be protected from hot sun and drying winds until it can be sprinkled or covered as above specified. The concrete surface shall not be damaged or pitted by rain. The Contractor shall provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours. The Contractor shall erect and maintain suitable barriers to protect the finished surface. Any section damaged from traffic, weather, people or other causes occurring prior to its final acceptance, shall be repaired or replaced by the Contractor in a manner satisfactory to the County's Representative.

G. **WEATHER LIMITATIONS.** Concrete shall not be placed where the air temperature is lower than thirty-five (35^0) degrees F. unless approved by the County's Representative. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulating covering to prevent freezing of the concrete for a period of not less than seven (7) days after placing. Equipment for protecting the concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing. Cold weather placement shall generally follow the requirements of ACI 306.1.

Hot-weather placement shall generally conform to the requirements of ACI 305. Advanced timing and scheduling to avoid delays in delivery, placing, and finishing are required during hot-weather placement of concrete. Reddi-mix trucks should be able to discharge immediately and adequate personnel should be available to place and handle the concrete. When possible, concrete deliveries should be scheduled to avoid the hottest part of the day. The concrete temperature can be lowered by using chilled water or ice as part of the mixing water.

4.8.2.2 CONCRETE REINFORCEMENT INSTALLATION. Concrete reinforcement (rebar) shall be installed in accordance with ACI (American Concrete Institute) standard requirements for reinforced concrete and generally as follows.

A. **BENDING.** Reinforcing bars shall be accurately formed to the dimensions indicated on the plans. Bends for stirrups and ties shall be made around a pin having a diameter not less than two (2) times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six (6) times the minimum thickness of the bar, except that for bars larger than one (1) inch, the pin shall be not less than eight (8) times the minimum thickness of the bar.

B. **SPLICING.** Splicing of bars at points other than where shown on the plans will be permitted only by approval of the County's Representative. Splices of reinforcement at points of maximum stress shall be avoided wherever possible, and when used shall be staggered and in accordance with ACI Standards. The minimum overlap for a lapped splice shall be twenty four (24) bar diameters, but not less than twelve (12) inches and properly tied together.

C. **PLACING.** All reinforcing bars shall be placed accurately in the position shown on the plans, and shall be securely held in position by annealed iron wire ties of not less than sixteen (16) gauge or suitable clips at intersections. All reinforcing bars shall be supported by metal supports, spacers or hangers, in such a manner that there will not be any displacement while placing concrete.

D. **EMBEDMENT AND PROTECTION.** All reinforcing steel shall be protected by concrete embedment and protective cover as shown in Table 4.31, such cover in each case being the shortest distance between the face of the form or concrete surface, and the nearest edge or face of the reinforcement.

TABLE 4.31
REINFORCING BAR CLEARANCE

LOCATION OF REINFORCEMENT	COVER
Bottom bars - where concrete is deposited against ground without use of forms.	Not less than 3"
Main bars - where concrete is exposed to the weather, or exposed to the ground but placed in forms.	Not less than 2"
Bars in slabs and walls not exposed to the ground or weather.	Not less than 1"

4.8.2.3 CURB, GUTTER AND SIDEWALK CONCRETE PLACEMENT. The concrete shall be placed either by an approved slipform/extrusion machine, by the formed method, or by a combination of both methods. Curb and gutter shall be placed as follows:

A. **MACHINE PLACEMENT.** The slipform/extrusion machine shall place, spread, consolidate, screed, and finish the concrete in one complete pass to provide a dense and homogeneous concrete section. A minimum amount of hand finishing should be necessary. The machine shall shape, vibrate, and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery, and spreading concrete shall provide for uniform progress, with stopping and starting of the machine held to a minimum.

B. **FORMED METHOD.** The forms shall be of wood, metal, or other suitable material straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of mortar. Flexible or rigid forms of proper curvature shall be used for curves having a radius of one hundred (100) feet, or less.

Forms shall be cleaned and coated with an approved form-release agent before concrete is placed against them.

The concrete shall be deposited into the forms without segregation and then tamped and spaded or mechanically vibrated for thorough consolidation. Forms shall be removed without damage to the concrete after it has set.

C. **FINISHING.** The concrete shall be finished smooth, by a wood or magnesium float and then given a final surface texture using a light broom or burlap drag unless otherwise specified or directed. Concrete that is adjacent to forms and formed joints shall be edged with a standard jointer or edging tool as shown in the standard drawings. The top, face, and flow-line of the curb, and the top of driveway apron, shall be finished true to line and grade without any noticeable surface irregularities.

The Contractor shall be responsible for neatly stamping an "S" in the curb face at all sewer lateral locations and a "W" in the curb face at all water lateral locations along the curb.

The gutter shall not pond water. No part of the exposed surface shall present a wavy appearance and any deviation in the surface shall not exceed more than one fourth (1/4) of an inch in ten (10) feet.

D. **JOINTING.**

D.1 Contraction (Control) Joints. Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding the values in accordance with standard drawings. Where the sidewalk abuts the curb and gutter, joints should align unless otherwise approved by the County's Representative. Joint depth shall at least be one quarter (1/4) of the cross section depth of the concrete. Generally, surface areas shall not exceed fifty (50) square feet without contraction joints unless otherwise approved by the County's Representative.

Contraction joints may be sawed, hand-formed, or made by placing division plates in the form-work. Sawing shall be done within twenty four (24) hours after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed either by using an appropriate jointing tool, or a thin metal blade to impress a plane of weakness into the plastic concrete, or by inserting one eighth (1/8) inch thick steel strips into the plastic concrete temporarily. Steel strips shall be withdrawn before final finishing of the concrete. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set while the forms are still in place.

D.2 Expansion Joints. Expansion joints for curb and gutter shall be constructed at right angles to the curb line at no greater than one hundred fifty (150) foot intervals, at immovable structures and at points of curvature for short-radius curves. Spacing for sidewalk expansion joint shall not exceed twenty (20) feet. Filler material for expansion joints shall conform to requirements of ASTM D-994, D-1751, or D-1752 and shall be furnished in a single one half (1/2) inch thick piece for the full depth and width of the joint.

Expansion joints in a slipformed curb and gutter shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. The cut shall be only wide enough to permit a snug fit for the joint filler. After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then troweled and edged. Contaminated concrete shall be discarded.

Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb and gutter, immediately installing temporary holding forms, placing the expansion joint filler, and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discarded.

D.3 Other Jointing. Construction joints may be either butt or expansion-type joints. Curbs and gutters constructed adjacent to existing concrete shall have the same type of joints as in the existing concrete with similar spacing; however, contraction joint spacing shall not exceed ten (10) feet.

A silicone joint sealer as defined in ASTM C 962 shall be applied to all form-plate expansion joints. The silicone joint sealer shall be applied under pressure to a depth of not less than two (2) inches from the outside surface of the curb and gutter.

E. **PROTECTION.** At all times during the construction of the project, the Contractor shall have materials available at the site to protect the surface of the plastic concrete against rain or other detrimental elements. These materials shall consist of waterproof paper, plastic sheeting or other approved material. For slip-form construction, materials to protect the edges shall also be required.

When concrete is being placed in cold weather and the temperature is expected to drop below 35 degrees F., suitable protection shall be provided to keep the concrete from freezing until it is at least seven (7) days old. Concrete damaged by frost action shall be removed and replaced.

F. **CURING.** Concrete shall be cured for at least three (3) days after placement to protect against loss of moisture, rapid temperature change, and mechanical damage. Liquid membrane curing compound, or other approved methods, or a combination thereof may be used as the curing material. Membrane curing shall not be permitted in frost affected areas when the concrete will be exposed to de-icing chemicals within thirty (30) days after completion of the curing period.

G. **BACKFILLING.** At least seven (7) days after placement and after form removal, the concrete shall be backfilled to the lines and elevations as shown on the drawings or as required by the County's Representative. Any concrete damaged during backfill or other operations shall be removed and replaced as directed by the County's Representative.

H. **CONCRETE REPAIR.** In lieu of removing and replacing concrete containing minor cracks, the County's Representative may direct the Contractor to repair the affected sections by sawing, routing, cleaning and sealing the cracks. All cracks repaired shall be sealed with polyurethane TTS-230 type II crack filler or an approved silicone base joint sealer. Where modifications are to be made to existing concrete, the edges to be placed against shall be sawcut in neat, straight lines and the new concrete shall be edged with a standard edging tool.

l. **WEATHER LIMITATIONS.** Concrete shall not be placed when there is likelihood of freezing. During the curing period, the concrete shall be protected by means of insulating covers to prevent freezing of the concrete for a period of not less than seven (7) days after placing. Equipment for protecting the concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing. Hot weather concreting shall be in accordance with the latest ACI 305 Standards for "Hot Weather Concreting".

4.8.2.4 CONCRETE BASE MATERIALS PLACEMENT. The placement of concrete base materials under curb, gutter and sidewalk shall conform to Section 4.5.7 of these standards.

4.8.3. QUALITY CONTROL. All concrete and base materials shall be placed in accordance with these standards and tested as follows. These are minimum requirements and additional testing may be required by the County's Representative or the Project Geotechnical Engineer.

Testing documentation provided to the County's Representative shall fully address the requirements of these standards.

4.8.3.1 CONCRETE TESTING. Minimum testing of the concrete shall be as follows:

Mix Design Certification:	One per job. Testing shall be according to the latest ASTM standards.
Compressive Strength Tests:	One set of four (4) cylinders for each fifty (50) cubic yards of concrete placed or portion thereof. Tests shall be according to ASTM C-31 and ASTM C-39.
Air Entrainment:	Tested at beginning of placement until two (2) consecutive loads pass. Other tests shall be taken as required. Tests shall be according to ASTM C-231.
Slump Tests:	Tested at beginning of placement until two (2) consecutive loads pass. Others tests shall be taken as required. Tests shall be according to ASTM C-143.

4.8.3.2 CONCRETE BASE MATERIAL TESTING. Minimum testing of the curb, gutter and sidewalk base materials shall be as follows:

Gradation Tests:	One test per five hundred (500) lineal feet of curb & gutter or fraction thereof. One test per one thousand three hundred fifty (1,350) square feet of a combination of sidewalk and driveway, or fraction thereof. The sieve analysis shall be according to ASTM C-136, C-117.
Proctor:	One determination for each source of base course as necessary to provide required compaction testing. Test shall be according to ASTM D-1557, Method A or D (modified proctor).
Moisture Density Tests:	One test per three hundred (300) lineal feet of curb & gutter and one test per three hundred (300) lineal feet of a combination of sidewalk and driveway or fraction thereof. Moisture content shall be at plus or minus two (2) percent of optimum. Proper moisture shall be maintained until the concrete is placed. Tests shall be according to ASTM D-1556 or D-2922 and D-3017.
Thickness:	One random boring or test hole per two hundred (200) lineal feet of curb & gutter and one random boring or test hole per two hundred (200) lineal feet of a combination of sidewalk and driveway or fraction thereof. If sufficient observation has been made by the County's Representative to verify required thickness, the County's Representative may waive thickness testing. No single measured thickness shall be less than the required thickness.

4.8.3.3 ACCEPTANCE. A total of four (4) concrete test cylinders shall be taken at time of pouring from loads passing the requirements of section 4.8.3.1. One cylinder, shall be broken at seven (7) days and shall be used as an indication of future strength. Two (2) cylinders shall be broken at twenty eight (28) days. If the average of the twenty-eight day breaks is below minimum compressive strength, the concrete may be rejected unless retests prove otherwise. At the Contractor's option, the fourth cylinder (the "hold" cylinder) may be broken at twenty eight (28) days, and included with the average, or it can be held for future testing if additional tests are needed.

Concrete with an average compressive strength below the required strength

shall be reviewed by the County's Representative. The "hold" cylinder, if available, may be broken or other specialized tests (such as a spectrum analysis) may be required. If additional tests are required to determine if strength tests are representative they shall be performed by coring in accordance with ASTM C-42 method or other acceptable non-destructive methods. The re-tested strength shall be the average of three cores (or other acceptable method). The County's Representative may accept the concrete as a result of these additional tests, or may require the work to be removed and replaced. The County's Representative shall make the final decision. All costs incurred in resampling and retesting are not the responsibility of the County.

4.9 RESTORATION OF EXISTING SURFACE IMPROVEMENTS.

4.9.1 INTRODUCTION. The Contractor shall be responsible for the protection and restoration, or replacement, of all existing improvements on public or private property and all improvements placed during the progress of the work. Existing improvements shall include, but not be limited to, asphalt, curbs, gutters, ditches, driveways, culverts, fences, signs, sidewalks, utilities, landscaping and walls, etc. All existing improvements damaged during construction shall be reconstructed to equal or better condition than that which existed. However, as a minimum, the requirements contained in these specifications shall be adhered to.

All traveled surfaces shall be maintained flush with the existing surfaces at all times until permanent repairs are completed.

Prior to the beginning of any work activity involving tunneling under, or making any excavation in any street, alley or other public place, the Contractor shall comply with all requirements for permits and bonding. The Contractor shall also comply, during the work activity, with all of the requirements contained within Section 2.5, BARRICADES AND WARNING SIGNS - WORK AREA PROTECTION, of these specifications.

4.9.2 GRAVEL SURFACES. Where existing gravel surfaces are damaged due to trenching or other works the surfaced areas (such as roads and driveways) shall be restored and maintained as follows.

- The gravel shall be placed deep enough to provide a minimum of six (6) inches thickness, or to match the thickness of existing material, or to these specifications, whichever is greater.

- The gravel shall be placed and compacted in the trench (or other work) at the time it is backfilled. The surface shall be maintained by blading, sprinkling, rolling, or adding gravel in order to maintain a safe uniform surface satisfactory to the County's Representative. Excess material shall

be removed from the premises immediately.

- Material for use on gravel surfaces shall conform to the requirements contained within these specifications.

4.9.3 BITUMINOUS SURFACES. Where an existing bituminous surface is damaged due to trenches or other works, the bituminous surfaced roads, driveways, parking areas, etc., shall be restored within five (5) days as follows:

- Mud or other soft or spongy material shall be removed from the trench and the space filled with granular backfill to within twelve (12) inches of finished grade. The granular backfill shall be rolled and compacted to a minimum of ninety-five (95) percent of maximum dry density in layers not exceeding six (6) inches in compacted thickness. Base gravel shall then be placed to a depth equal to the original gravel base or the requirements of these specifications, but not less than six (6) inches thick and compacted to a minimum of ninety five (95) percent of maximum dry density.

- Prior to permanent resurfacing, the Contractor shall saw-cut the existing paving to provide vertical, clean, straight lines as nearly parallel to the centerline of the trench as practical. The existing bituminous paving shall be cut back beyond the limits of any excavation so that the edges of the new paving will rest on at least six (6) inches of undisturbed base material.

- Pavement restoration shall include tacking of pavement edges with type SS-1H bituminous material, and placing and compacting plant mix asphalt in accordance with these specifications to the level of the adjacent pavement surfaces.

- The bituminous surface shall be restored by standard paving practices to a thickness equal to the original pavement or the requirements of these specifications, but in no case less than three (3) inches. The finished repaired surface shall not deviate more than one quarter (1/4) inch (vertically) from the existing road surface. Any deviations greater than that specified shall be immediately removed and replaced to the proper standards.

4.9.4 CONCRETE SURFACES. All concrete curbs, gutter, sidewalks, and driveways shall be removed and replaced to the next joint or score line beyond the actually damaged or broken sections; or saw-cut to neat, plane faces. All new concrete shall match, as nearly as possible, the appearance and texture of adjacent concrete improvements unless adjacent improvements do not meet these specifications.

All damaged base material shall be restored and compacted in accordance with these specifications.

SECTION 5

SIGNING AND PAVEMENT MARKINGS

5.1 INTRODUCTION. This section covers street signing and pavement markings.

5.2 SIGNING MATERIALS, FABRICATION AND PLACEMENT. All traffic, street name and other roadside signage shall follow the requirements for materials, fabrication and installation outlined in the standard drawings and these specifications.

5.2.1 STREET NAME SIGNS. The sign face materials shall consist of reflective "high intensity" grade sheeting (or better). "Engineer" or similar grade materials shall not be used. The sign face colors shall be green for public streets and blue for private streets. The street sign blanks shall consist of high tensile, degreased aluminum in accordance with the standard drawings. The street name sign face layout detail, as shown on standard drawings, shall be followed. The "Street Name Sign Designation Form" found in the standard drawings shall be completed and approved by the County Address Coordinator prior to the fabrication and installation of any new street name signs. All street name signs shall include address coordinates.

The street name signs shall be installed on galvanized steel posts that conform to the requirements contained in the standard drawings. The installation method and location shall be in accordance with the standard drawings and the MUTCD.

5.2.2. TRAFFIC SIGNS. All traffic signs shall conform to the requirements relating to color, retroreflectivity, face, size, markings, lettering and location of installation found in the Manual of Uniform Traffic Control Devices for Streets and Highways (MUTCD). Traffic sign face material shall consist of reflective "high intensity" grade sheeting at a minimum (ASTM D4956 Type III or higher).

Traffic sign blanks shall consist of 0.1 inch thick high tensile degreased aluminum alloy in accordance with 6061-T6, with alodine 1200 finish.

All traffic signs shall be installed on galvanized steel posts in accordance with the standard drawings.

5.2.3 VISIBILITY. All street name and traffic signs shall be installed in such a manner as to provide adequate advance visibility for an approaching driver in accordance with MUTCD and other approved standards.

5.3 PAVEMENT MARKINGS. Pavement markings shall include all traffic lane striping, pavement words and symbols, and other traffic oriented street markings.

The standards regarding color, type, size and layout of pavement markings *Manual on Uniform Traffic Control Devices for Streets and Highways*. However, in such cases where the Utah Department of Transportation standards take precedence, they should be followed.

5.3.1 LINE TYPES

A. SOLID LINES. Solid lines shall consist of a four (4) inch wide solid white or yellow lines.

B. SKIP (BROKEN) LINES. Skip lines shall consist of line segments and gaps on a 3 to 1 ratio. The line segment shall be four (4) inches wide (white or yellow line) and generally ten (10) feet long. The gap segment shall generally be thirty (30) feet long.

C. DOUBLE LINES. A double line shall consist of two four (4) inch wide solid yellow lines separated by a minimum four (4) inch wide space.

D. LANE LINES. Lane lines shall consist of a four (4) inch wide skip line, white in color. Lane lines separate lanes of traffic travelling in the same direction. A four (4) inch wide or wider solid white line may be used as the lane line in critical areas where it is advisable to discourage lane changing, such as on bridges having width restrictions and in intersection areas where lane changing disrupts traffic flow.

E. STOP BARS. Stop bars shall be white. Width shall be two (2) feet, unless otherwise directed.

5.3.2 PAVEMENT WORD AND SYMBOL MARKINGS. Shall be in accordance with the MUTCD.

5.3.3 TRAFFIC PAINT. Traffic paint shall conform to the latest requirements contained in the State of Utah Department of Transportation "Standard Specifications for Road and Bridge Construction". Traffic paint shall be applied only when all of the following conditions are met:

A. The air temperature is above forty (40) degrees Fahrenheit.

B. The temperature of the surface to be painted is between forty (40) and one hundred (100) degrees Fahrenheit.

C. The surface to be painted is clean and dry, and

D. The weather is not windy, foggy or humid.

Painting shall be done in a neat and workmanlike manner. Paint shall be applied smoothly and uniformly in accordance with the manufacturer's specifications. The finish shall be uniform in appearance and coverage.

5.3.4 TEMPORARY MARKINGS. Temporary markings may be required until permanent markings can be properly placed. Temporary pavement markings shall be reflectorized traffic paint or other material approved by the County's Representative.

5.3.5 RAISED PAVEMENT MARKERS. Raised pavement markers shall conform, in terms of materials and application, to the latest standards found in the requirements of the State of Utah Department of Transportation or other approved standards and shall be approved for use prior to application.