

*DESIGN AND CONSTRUCTION
STANDARDS*



SECTION 1

INTRODUCTION



1.1	INTRODUCTION	3
1.2	DEFINITIONS	3
1.3	BONDS AND INSURANCE	11
1.4	STARTING AND COMPLETING THE WORK	11
1.5	PRECONSTRUCTION CONFERENCE	11
1.6	APPROVED DOCUMENTS INTENT	11
1.7	AMENDING AND SUPPLEMENTING THE APPROVED DRAWINGS	13
1.8	UNDERGROUND FACILITIES SHOWN OR INDICATED	13
1.9	UNDERGROUND FACILITIES NOT SHOWN OR INDICATED	13
1.10	REFERENCE POINTS AND MONUMENTS	14
1.11	CONTRACTOR'S RESPONSIBILITIES - SUPERVISION AND SUPERINTENDENTS	14
1.12	SAFETY AND PROTECTION	15
1.13	CLARIFICATIONS AND INTERPRETATIONS	16
1.14	SITE EMERGENCIES	17
1.15	AUTHORIZED VARIATIONS IN WORK	17
1.16	REJECTING DEFECTIVE WORK	17
1.17	WARRANTY AND GUARANTEE	17
1.18	TESTS, INSPECTIONS AND OBSERVATIONS	17
1.19	CONTRACTOR EMPLOYEES	19
1.20	HISTORIC, ARCHAEOLOGICAL OR PALEONTOLOGICAL DISCOVERIES	19
1.21	WORKING HOURS FOR ALL PUBLIC PROJECTS	19
1.22	UNCOVERING WORK	20
1.23	CITY'S REPRESENTATIVE MAY STOP THE WORK	20
1.24	CORRECTION OR REMOVAL OF DEFECTIVE WORK BY CONTRACTOR	20
1.25	ONE-YEAR CORRECTION PERIOD	20
1.26	ACCEPTANCE OF DEFECTIVE WORK	21
1.27	CORRECTION OR REMOVAL OF DEFECTIVE WORK BY OWNER	21
1.28	WORK FULLY COMPLETED	21
1.29	FINAL ACCEPTANCE	22
1.30	SUSPENSION OF WORK	22
1.31	CONSTRUCTION PERMIT EXPIRATION	22
1.32	MISCELLANEOUS	22

SECTION I INTRODUCTION

1.1 INTRODUCTION.

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.

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

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.

ADDENDA: Written or graphic instruments issued prior to the opening of bids which supplement, clarify, correct, or change the bid documents or the contract documents.

ANSI: The American National Standard Institute.

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

APPROVED DRAWINGS: The graphic and pictorial portions of the approved documents, approved by the City'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.

ASTM: The American Society for Testing Materials.

AWWA: The American Water Works Association.

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

BENCHMARK: 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.

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

CHANGE ORDER: A written instrument prepared by The City's Representative, signed by The Contractor on or after the effective date of the agreement, which authorizes an addition, deletion, or revision in the work, or an adjustment.

CITY: The City of La Verkin, Utah, a governmental entity having authority to adopt and enforce ordinances.

CITY ENGINEER: The person appointed by the municipality to be the municipal engineer.

CITY'S REPRESENTATIVE: The person designated to act for and on behalf of The City.

CITY SURVEYOR: The officially designated Professional Surveyor who acts in the capacity as The City Surveyor.

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

CUSTOMER: One for whom the city-related services are rendered.

DAY: Any twenty-four-hour period measured from midnight to the next midnight.

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.

DEFECTIVE WORK: The work that is unsatisfactory, faulty, or deficient, or does not conform to the approved documents, or 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 City Representative's final inspection.

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.

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.

DRAWINGS: The graphic and pictorial portions of the submitted documents approved by The City's Representative showing the design, location, and dimensions of the work, and generally include the plan, elevations, sections, details, schedules, and diagrams.

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 City policy and ordinances.

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

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.

FIELD AGREEMENT: A written agreement signed by the Contractor and the City's Representative or Resident Project Representative, which orders minor changes in the work.

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

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

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

FINAL INSPECTION PUNCH LIST: A written list of work discrepancies and deficiencies compiled by The City's Representative at the final inspection.

FIRE CHIEF: The officially appointed person designated as the Hurricane Valley Fire Chief for the Hurricane Valley fire department, or his designated representative.

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

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 shall not be encroached upon by construction, fill, or other development.

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.

HILLSIDE DEVELOPMENT STANDARDS: The standards, as noted in The City's Hillside Ordinance, shall be used in all hillsides overlay zones.

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

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

JOINT UTILITY COMMITTEE (JUC): A formal group of representatives from public and private utility companies shall meet as needed to review and approve utility plans as required.

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

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

MODIFICATION: Any change order, field agreement, or work directive change.

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

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.

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).

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

PARTIAL UTILIZATION: Placing a portion of the work in service for the purpose for which it is intended (or a related purpose) before reaching substantial completion of all the work.

PEDESTRIAN ACCESS: A trail system and/or sidewalk to keep pedestrians separated from motor vehicle traffic.

PLANS (DRAWINGS): The graphic and pictorial portions of the documents approved by The City'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.

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

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

PUBLIC IMPROVEMENTS: The work or improvements, which are dedicated to and maintained by the City for the benefit of the Public-at-large.

PUNCH LIST TIME: The number of calendar days specified in the agreement for the completion of the final inspection punch list work.

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.

SOILS REPORT (GEOTECHNICAL REPORT): That report produced by the Owner's Geotechnical Engineer and submitted to The City, which describes the existing conditions, for the foundation soils of the lands being considered for development by The Owner. The said report also sets forth said Engineer's recommendations concerning the requirements of said soils for the intended use. (A soils report is the same as a geotechnical report.)

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.

STANDARD SPECIFICATIONS: The specifications contained in these documents.

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

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.

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.

SUB GRADE: Sub grade shall refer to the native, prepared original soil or engineered fill under any roadway, fill, embankment, structure, etc.

SUPPLEMENTARY CONDITIONS: Part of the approved documents which amends or supplements the Standard Specifications.

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

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.

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

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

UNDERGROUND FACILITIES: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, (as well as any encasement containing such 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.

WATER DEPARTMENT: Shall refer to The City's Water Department and its authorized City Representative.

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.

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

WRITTEN AMENDMENT: A document signed by The Contractor and The City on or after the effective date of the agreement.

XERISCAPE: Desert-type landscaping requires low-water demand as approved by The City.

- 1.3 BONDS AND INSURANCE. When the Contractor delivers the executed agreement to The City, The Contractor shall also deliver such bonds and insurance certificates as may be required by The City.
- 1.4 STARTING AND COMPLETING THE WORK. No work shall be done at the site prior to receipt of the notice to proceed. The Contractor shall provide a contact office and telephone number, if the contact office is greater than 50 miles from the job site and if required by The City, or desired by The Contractor. The Contractor shall provide a temporary field office in the vicinity of the project. This office shall be in such a location that the City's Representative may contact the Contractor for transmittal of plans, instructions, and dissemination of project information. The Contractor shall provide and maintain a telephone in the field office during the life of the project.
- 1.5 PRECONSTRUCTION CONFERENCE. Before the Contractor starts the work at the site, the Contractor will attend a conference with the City's Representative and others to:
- 1) Discuss the work progress schedule.
 - 2) Designate the name of the individual who shall always have the authority to act for the Contractor while work is in progress.
 - 3) Establish a working understanding among the parties as to the work.

When the Contractor is comprised of two or more persons, firms, partnerships, or corporations functioning on a joint-venture basis, before starting work, the Contractor shall designate in writing the name of a representative who shall have the authority to represent and act for the joint venture persons, firms, partnerships, or corporations at all times while work is actually in progress.

- 1.6 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 The City 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, the Contractor finds a conflict, error, or discrepancy in the approved plans or these standards, the Contractor shall so report to The Owner and The City's Representative at once and before proceeding with the work affected thereby shall obtain an interpretation or clarification from The Owner's Engineer and The City'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 the 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, the City's Representative shall be the sole judge of whether the work or materials deviate from the approved documents, and the City Engineer's decision as to any allowable deviations therefore shall be final. Deviation from approved documents, as may be required by the needs of construction, will be determined in all cases by the City Engineer or His Authorized Representative. In the

event of a conflict between the engineered drawings and these standards, the standards will apply.

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 City Engineer's decision shall be final.

- 1.7 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 City Engineer or his Authorized Representative prior to the start of construction of revised work.
- 1.8 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, is generally based on information and data furnished by others. Unless it is otherwise agreed to:
 - 1) The City shall not be responsible for the accuracy or completeness of any such information and data,
 - 2) The 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.
- 1.9 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 submitted documents, and which

the Contractor could not reasonably have been expected to be aware of. The Contractor shall promptly, after becoming aware thereof and before performing any work affected thereby (except in an emergency), identify the Owner of such underground facility and give notice thereof to that owner and to The City's Representative. The City's Representative will promptly review the underground facility to determine the extent to which the submitted documents should be modified to reflect and document the consequences of the existence of the underground facility, and the submitted documents will be amended or supplemented to the extent necessary.

- 1.10 REFERENCE POINTS AND MONUMENTS. The Owner's Representative shall establish land survey reference points for construction to enable the 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 The City's Representative. The Contractor shall report to The City'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 City's Representative. No survey monument shall be disturbed or moved until the City's Representative has been notified and the Owner's Representative has referenced the survey monument for resetting.

- 1.11 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 to see that the finished work complies accurately with the approved documents.

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

1.12 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, other persons, and organizations that may be affected thereby;
- 2) All work, 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 regulations of any public body having designated for removal, relocation, or replacement in the course of construction. The Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for the safety of persons or property, or to protect them from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

The Contractor shall notify The Owners of adjacent properties and of underground facilities and The 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 The Contractor. The Contractor's duties and responsibilities for the safety and protection of the work shall continue until such time as all of the work is completed, and the City's Representative has issued a notice to The Contractor that the work is acceptable.

The City, its Officers, Employees and Agents, and The City'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.

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 City may make or cause to be made such temporary repairs as are 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 City shall not in any way be construed to limit The Contractor's full responsibility for the safety of all persons on the premises.

- 1.13 CLARIFICATIONS AND INTERPRETATIONS. The City's Representative will issue, with reasonable promptness, such written clarifications or interpretations of the requirements of the submitted documents as The City's Representative may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the submitted

documents. Should it appear that the work or any of the matters relative thereto are not sufficiently detailed or explained in the submitted documents, the Contractor shall request the City's Representative to provide such further explanations as may be necessary for the Contractor, which shall be done, and the Contractor shall conform to them as part of the work.

- 1.14 SITE EMERGENCIES. In emergencies affecting the safety or protection of persons or the work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from The City's Representative, is obligated to act to prevent threatened damage, injury, or loss. The Contractor shall give The City's Representative prompt written notice if The 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 City's Representative prior to the start of construction of the variation.
- 1.16 REJECTING DEFECTIVE WORK. The City'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. The Contractor warrants and guarantees to The City 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 City.
- 1.18 TEST, INSPECTIONS, AND OBSERVATIONS. The Contractor shall give The City's Representative at least twenty-four 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 the Contractor's Expense. Any re-inspection that is

caused by the Contractor not being ready will be charged a \$50.00 fee for each re-inspection.

The City'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 The City's Representative and The Owner's Engineer, Contractor shall assume full responsibility and furnish The City's Representative the required certificates of inspection, testing, or approval.

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

All work and materials, and the manufacture and preparation of such materials incorporated in the work, or of materials or equipment submitted for approval prior to the beginning of the work until work completion, shall be subject to acceptance or rejection by The City'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 The City's Representative.

Inspection by the City's Representative shall not relieve the Contractor from responsibility to furnish material and workmanship in accordance with the approved documents.

Failure on the part of The City'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 City'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 The Contractor, The Sub-Contractor themselves, or The Subcontractor Employees, who is found by The City'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.

The Contractor shall have the right to appeal this decision to the City Administrator and then, if not satisfied, to the City Council.

- 1.20 HISTORIC, ARCHAEOLOGICAL, OR PALEONTOLOGICAL DISCOVERIES. If a suspected historic, archeological, or paleontological item, feature, or site is encountered, construction operations shall be immediately stopped in the vicinity of the discovery, and the City's Representative and all 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 and shall provide written confirmation of the discovery to The City's Representative and all proper State and/or Federal Agencies within two calendar days.

The Contractor shall not damage the discovered objects. The Owner shall keep The City's Representative informed as to the status of any restrictions placed upon the project and when such restrictions are removed.

- 1.21 WORKING HOURS FOR ALL PUBLIC WORKS PROJECTS. Construction activities on City-contracted work shall comply with any applicable local noise and other ordinances. Unless otherwise directed or upon approval of different hours by The City's Representative, working hours at the work site shall be limited to between 7:00 A.M. and 7:00 PM local time. Work shall not proceed on Saturday, Sunday, or on any legal holidays that require inspections by The City, without prior approval from The City's Representative.

- 1.22 UNCOVERING WORK. If any work is covered or buried contrary to the request of The City'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 CITY'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 completed work will not conform to the approved documents, The City's Representative may order The 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 City's Representative, the Contractor shall promptly, as directed, either correct all defective work, whether or not fabricated, installed, or completed, or if the work has been rejected by The City'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 City, Engineers, Architects, Attorneys, and other Professionals made necessary thereby).

- 1.25 ONE-YEAR CORRECTION PERIOD. If within the one-year warranty period, or such longer period of time as may be prescribed by laws or regulations, or by the terms of any work, is found to be defective regardless of cause, The Owner shall promptly cause the applicable special guarantee required, or by any specific provision of the approved documents, The Contractor, without cost to The City, either correct such defective work, or, if it has been rejected by The City, 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 City 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 City prefers to accept it, the City may do so. The Owner shall bear all direct, indirect, and consequential costs attributable to The City's Representative evaluation of and determination to accept such defective work.
- 1.27 CORRECTION OR REMOVAL OF DEFECTIVE WORK BY OWNER. If The Owner fails within a reasonable time after written notice of The City's Representative to proceed to correct defective work or to remove and replace rejected work as required by The City's Representative, or if The Contractor fails to perform the work in accordance with the approved documents, The City may, after seven days' written notice to The Owner, correct and remedy any such deficiency. 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 the Contractor considers the work (or portion thereof) ready for its intended use, the Contractor shall certify in writing that the work (or portion thereof) is ready for its intended use. The Contractor shall certify in writing to The City's Representative that the work (or portion thereof) has been completed in accordance with the submitted documents. The Contractor shall include in such written certification a list of any work deficiencies. Within ten days after The City's Representative receives The Contractor's certification and list of work deficiencies, The City's Representative will issue written notice either accepting the work as fully completed or stating reasons why the work is not fully completed. If fully completed, the City's Representative shall, within a reasonable time, schedule a final inspection preparatory to writing the final inspection punch list. The City shall have the right to exclude The Contractor from the work after the date of full completion, but The City shall allow The Contractor reasonable access to complete or correct items on the final inspection punch list.

- 1.29 FINAL ACCEPTANCE. If, on the basis of The Owner's and The Contractor's request that work be given final acceptance and The City's Representative is satisfied that the work has been satisfactorily completed, The City's Representative will give written notice to The Owner that the work is acceptable, and the warranty period will start. Otherwise, the City's Representative will indicate in writing to the Owner the reasons for refusing to recommend final acceptance, in which case Owner shall make the necessary corrections and resubmit the request for final acceptance approval.
- 1.30 SUSPENSION OF WORK. The City's Representative shall have the authority to suspend the work wholly or in part for such period as The City's Representative may deem necessary due to unsuitable weather or for such other conditions The City's Representative considers unfavorable for the suitable prosecution of the work. The Contractor shall immediately comply with The City's Representative's 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 City's Representative. In the event the suspension of work is ordered for any reason, the Contractor, at the Contractor's expense, shall do 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 City may perform such work, and the cost thereof will be billed to the Contractor or Owner.
- 1.31 CONSTRUCTION PERMIT EXPIRATION. If an inspection request is not received within the twelve-month period after issuing a construction/grading permit, any approved drawing or permit shall expire. One six (6) month extension will be considered if the Developer submits requests in writing for an extension prior to the date of expiration of the permit.
- 1.32 MISCELLANEOUS. Giving Notice - Whenever any provision of the submitted documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of

the firm or to an officer of the corporation for whom it is intended, or if delivered to or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

COMPUTATION OF TIME: When any period of time is referred to in the contract documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

GENERAL: Should The City or The Contractor suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

SECTION 2

GENERAL REQUIREMENTS



2.1 INTRODUCTION	27
2.2 CONSTRUCTION DRAWINGS	27
2.2.1 GENERAL	28
2.2.2 SUBMITTAL REQUIREMENTS	29
2.2.3 CURB AND GUTTER, DRAINAGE, SIDEWALK AND STREET	29
2.2.4 SEWER	31
2.2.5 CULINARY WATER	31
2.2.6 SECONDARY WATER	31
2.2.7 POWER	31
2.2.7.1 LIGHTING	32
2.2.8 DETAIL SHEETS	33
2.2.9 GRADING PLAN AND PERMIT REQUIREMENTS	33
2.2.10 GENERAL UTILITY LOCATION INFORMATION	33
2.3 INSPECTION, TESTING AND QUALITY CONTROL	34
2.3.1 REQUESTS FOR INSPECTION	35
2.3.1.1 PAVING INSPECTION	35
2.3.2 CONSTRUCTION COMPLETION INSPECTION	35
2.3.3 PERFORMANCE BOND OR EQUIVALENT	36
2.3.3.1 UTILITY EXEMPTIONS	36
2.3.3.2 TYPE OF BOND OR GUARANTEE	36
2.3.3.3 AMOUNT OF BOND	37
2.3.3.4 DURATION OF BOND	37
2.3.3.5 FINAL INSPECTION PARTIAL RELEASE OF BOND OR DEFAULT	37
2.3.3.6 FINAL CITY ACCEPTANCE	38
2.3.3.7 DEFAULT	39
2.3.3.8 BOND FORFEITURE	40
2.3.3.9 SUBDIVISION IMPROVEMENTS AND COST OVERRUN AGREEMENTS	40
2.3.3.10 ABSENCE OF BOND	41
2.3.3.11 NECESSITY OF REPAIRS	41
2.3.4 QUALITY CONTROL TESTING	42
2.3.5 TEST REPORTS	42
2.4 DRAWINGS OF RECORD	42
2.4.1 ELECTRONIC FILES FOR DRAWINGS OF RECORD	43
2.4.2 DATA COORDINATE SYSTEM	45
2.5 TRAFFIC CONTROL	45
2.5.1 GENERAL TRAFFIC CONTROL REQUIREMENTS	46

2.5.2 ROAD CLOSURES	48
2.6 COOPERATION WITH UTILITIES	49
2.7 COOPERATION BETWEEN CONTRACTORS	50
2.8 CONSTRUCTION STAKES, LINES AND GRADES	50
2.9 EXPLOSIVES AND BLASTING MATERIALS	51
2.9.1 COMMAND, CONTROL, AND PERMITS	51
2.9.2 BLASTING CRITERIA	52
2.9.3 ELECTRIC DETONATION METHOD	55
2.9.4 NON-ELECTRIC DETONATION	55
2.9.5 EXPLOSIVES AND ACCELERANTS	55
2.9.6 NOTES	56
2.9.7 STORAGE AND TRANSPORTATION	56
2.9.8 STEMMING	57
2.9.9 FLY ROCK	57
2.9.10 LOGS	57
2.10 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE	59
2.11 SURVEY MONUMENTS	59
2.12 HAZARDOUS MATERIALS DISCOVERIES	62
2.13 IMPROVEMENT SEQUENCE	63

SECTION 2

GENERAL REQUIREMENTS

- 2.1 INTRODUCTION. This section defines the general requirements for public improvements. The improvements shall include all public and private infrastructures, including, but not limited to, streets, water, secondary water system, 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 the appropriate City's Master 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 and drawings of improvements shall be submitted to the City's Representative. All plans, drawings, and reports submitted shall be stamped and signed by a professional Civil Engineer licensed in the State of Utah. No construction shall be started until plans have been checked and approved by the City's Representative, and/or other appropriate City Officials.

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

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

The size of drawings shall be twenty-four by thirty-six inches.

Drawings shall be submitted electronically by email or on digital storage media, including a flash drive or external hard drive.

All drawings shall be submitted in Utah State Planes; NAD83 datum, South Zone, US Foot coordinates.

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

- o Date of preparation and North arrow.
- o The proposed name of the subdivision.
- o The location of the subdivision, including the address and the section, township, and range.
- o All plans, drawings, and reports submitted shall be stamped and signed by a professional Civil Engineer licensed in the State of Utah.
- o The name and address of The Owner and The Subdivider, if other than The Owner.
- o Scale and elevations referenced to the latest revision of U.S.G.S. datum. The Scale shall be of sufficient size to adequately describe in legible form all required conditions of this subdivision title.
- o Stationing and elevations for profiles.
- o Signature blocks along the bottom and to the right side for the following: City Public Works, City Engineer, Ash Creek Special Service District, Century Link, Enbridge, Rocky Mountain Power, Hurricane Valley Fire District, Info West and TDS Telecom.
- o Project Title and Location centered at top.
- o Engineer's or Surveyor's certificate. Legal Description and Owner's Dedication on the right side of the page.
- o Revision block located in or above the title block containing the revision number, description, date, and reviser's name.
- o A heavy border outlining the entire sheet.

- o Finish Pad elevations on each building lot.

1) Retaining Walls: Where there are elevation changes of two feet (2') or greater between any building pad and its property line within the subdivision boundary, such retaining walls shall be built. The construction materials shall be consistent throughout the entire subdivision and shall be similar in color to the strata of the adjacent property at a similar elevation.

- o Color coding for utility conduits/lines as follows:

Power	Red
Water (Culinary)	Blue
Irrigation	Purple
Sewer	Green
Gas	Yellow
Phone	Orange
Cable TV	Orange

2.2.2 SUBMITTAL REQUIREMENTS. One PDF plan shall be submitted to The City, The City Engineer, Rocky Mountain Power, Qwest, Cable company, Enbridge Gas, Ash Creek Special Service District, Info West and Hurricane Valley Special Service District for checking. When all corrections have been made and the set approved, (1) set of signed construction plans shall remain with The City. Another approved paper set shall be kept available at the construction site, at all times, during the construction of the project.

2.2.3 CURB AND GUTTER, DRAINAGE, SIDEWALK, AND STREET. The drawings for curb and gutter, drainage, sidewalks, and streets shall contain:

- o 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.

- o 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, mid-points and P.T.'s. At all street intersections, elevations shall be shown at the half delta points (minimum).
- o Standard engineering stationing and all curve data.
- o Plan and profile details of the drainage system showing flow directions and types of pipe.
- o Benchmark locations and elevations (latest revisions of USGS datum must be used).
- o Typical street cross-section from right-of-way line to right-of-way line showing type of curb, sidewalk, and pavement section.
- o Gradient centerline of roads, top, back of curbs (if different from centerline), or edge of pavement (if different from centerline and no curb exists), and flowlines of drainage pipes and channels. Profiles shall be shown at all intersections to ensure that street grades transition smoothly. Transition grades shall not be left to be worked out in the field!
- o Location of existing and proposed permanent survey monuments.
- o Profiles shall show the existing ground profile at the centerline and each right-of-way line.
- o 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 from the opposite side of the street, cross-sections shall be shown indicating how the new portion will match.

- o Finish pad elevations.
- o Street lighting, regulatory signs, non-regulatory signs, and pavement markings.

2.2.4 SEWER. Please refer to Ash Creek Special Service District Standards.

2.2.5 CULINARY WATER. Culinary water drawings shall contain:

- o Size, location, and type of all existing and proposed water mains, valves and hydrants, service laterals, and all necessary appurtenances.
- o Profile drawings showing high and low elevation with respect to grade.
- o Minimum cover shown (thirty-six inches to top of pipe).
- o Typical and special trench details showing bedding, backfill, compaction, and shoring requirements (See Standard Drawings).
- o Cross Connection Control and Backflow Prevention devices.

2.2.6 SECONDARY WATER. Secondary water drawings shall contain:

- o Size, location, and type of all existing and proposed irrigation mains, valves, service laterals, and all necessary appurtenances.
- o Profile drawings showing high and low elevation with respect to grade.
- o Minimum cover shown (thirty-six inches to top of pipe).
- o Typical and special trench details showing bedding, backfill, compaction, and shoring requirements (See Standard Drawings).

2.2.7 POWER. Power drawings shall contain:

- o Point of interconnect (to be determined before plans are prepared by contacting Rocky Mountain Power).
- o Location of existing and proposed transformers, service boxes, streetlights, etc.
- o Primary, secondary, and service lines and phasing details.
- o Topography and proposed grading, unless shown on grading plans.
- o Sizes, capacities, and characteristics of all components (e.g., wire, transformers, etc.).
- o Other requirements as per Rocky Mountain Power.

2.2.7.1 LIGHTING. Street lighting drawings shall address lighting at intersections, public facilities, trails, and crosswalks. Drawings must be sufficiently complete to enable The City to determine compliance with the requirements of these Standards. If the City Staff indicates that such plans cannot enable this determination, the applicant shall be required to additionally submit as evidence of compliance certified reports by a recognized laboratory that the plan meets city requirements. Lighting Drawings shall include the following:

- o The location and type of illuminating devices.
- o A description of the illuminating devices. Submissions may include information and drawings from manufacturers.
- o Photometric data, such as that furnished by manufacturers or similar data showing the angle of cutoff and level of light emissions.

- o Use of Nonstandard Streetlights: If the Subdivider proposes a lighting plan that uses nonstandard streetlights, the plan must be reviewed by the Planning Commission for its recommendation and then approved by the City Council. Unless agreed to by The City Council, The City will not accept public dedication of, and will not assume any costs associated with installation, operation, and maintaining of nonstandard lights, even if there is an attempt to dedicate such lights to The City.

2.2.8 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:

- o Scale of each detail if appropriate.
- o Title block on the right side of the sheet (same format on all sheets).
- o Name of the development.
- o All details must be completely dimensioned and described.
- o All details shall conform to the City's Standard drawings.

2.2.9 GRADING PLAN AND PERMIT REQUIREMENTS. Refer to LaVerkin code 9-1-16

2.2.10 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 City as required.

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

- o The Water (Culinary & Irrigation), sewer, and drainage layouts shall be the first utilities designed.
- o For joint trench details, placement and layout of utilities and burial depths, see standard drawings.
- o A joint trench for phone, cable, and power shall be located on the north and west side of roadways, back of sidewalk within new developments (whenever possible) or opposite gas. In planned developments without sidewalks, joint utility trenches shall be thirty-six inches back of curb.
- o Water and gas lines shall be located on the south and east sides of roadways. Gas lines shall be located five feet (5') behind the sidewalk or the curb if there is no sidewalk (whenever possible). Gas and water line stubs will be placed five feet (5') and three feet (3') respectively, to the right and left of the property line, with gas on the left and water on the right, when looking from the street at the lot to be served (See Standard Drawings).
- o *Sewer lines will generally be located fifteen (15) feet from the curb and gutter on the same side of the road as the power system.*
- o Storm drain lines will be placed at the inside lip of the curb and gutter as per standard drawing detail.
- o The cable TV and phone boxes will be located on the right and left side of the power transformers and secondary boxes. The cable shall be on the left and the phone on the right, looking from the street at the lot to be served.

2.3 INSPECTION, TESTING, AND QUALITY CONTROL. All construction work involving the installation of improvements in the City shall be subject to inspection and testing as outlined in the quality control section of each specification. Certification from the developer's professional engineer may be required for all or part of the project upon completion of the project.

2.3.1 REQUESTS FOR INSPECTION. A request for inspection shall be made to the City by the person responsible for the construction. Notice shall be given at least twenty-four hours before any work requiring backfill or cover. All work requiring backfill or cover shall not be backfilled or covered prior to inspection. Any inspection or observation by The City is for The City's sole use and does not relieve The Contractor or Developer from complying with The City Standards. The City may provide '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.

2.3.1.1 PAVING INSPECTION The following conditions must be met prior to paving:

- o Notice shall be given at least forty-eight hours before any work.
- o Compaction test results for all underground and subgrade work must be submitted.
- o Compaction and gradation test results for road base must be submitted.
- o A visual compaction inspection must be made next to all finished concrete edges. A pre-paving inspection must be conducted by the City. The City will retain a paving inspector for the project, the cost of which will be borne by the Developer.

2.3.2 CONSTRUCTION COMPLETION INSPECTION. The project must be 100% complete as determined by The City. After all construction work is complete, the Developer shall request, in writing, a "Construction Completion Inspection". Upon receipt of the request, the City shall

schedule this inspection with the appropriate parties. Any faulty or defective work shall be detailed in The City's inspection report. All faulty and defective work shall be corrected within 30 days from the date of The City's inspection report. If, after thirty days, the faulty or defective work has not been completed, another "final inspection" may be conducted by the City 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. A final report of compliance will be required from the Contractor upon completion of the project. This report will include all test results, drawings of record, and any other items required in the plans and specifications. A certification of compliance with minimum inspection and testing requirements as set forth herein must be submitted for any subdivision, planned unit development, and/or other developments which contain private streets. This certification must be on a form approved by The City and certified by a Professional Engineer licensed in the State of Utah.

- 2.3.3 PERFORMANCE BOND OR EQUIVALENT: To ensure proper backfill and restoration of the surface, the permittee shall deposit a surety bond with the city clerk/recorder, payable to the city.

Refer to sections 7-4-3 and 11-7-2 through 11-7-5 of the LaVerkin city code

- 2.3.3.1 UTILITY EXEMPTIONS: A public utility operating or using any of the streets under a franchise from the City will not be required to furnish such bond, providing such franchise obligates the holder thereof to restore the streets and to hold the City harmless in the event of any injury to any person or damage to any property due to negligence of such holder in conducting excavation and restoration operations under such franchise.
- 2.3.3.2 TYPE OF BOND OR GUARANTEE. The bond or guarantee shall be in the form of cash deposited with The City and held in an interest-bearing account, or a letter of irrevocable

credit from an approved institution, or such other cash security bond as The Subdivider may obtain that is approved by The City. Refer to sections 9-3-16 and 11-7-4 through 11-7-5 of the LaVerkin City Code.

- 2.3.3.3 **AMOUNT OF BOND.** The bond shall be equal to Ten percent (10%) of the total cost of all subdivision improvements. The Subdivider shall furnish an estimate of the cost of constructing the required improvements. Said estimate shall be prepared by an engineer registered to practice in the state. However, no estimate may be used as the basis for the amount of the bond until it has been approved by the City Engineer. Refer to 11-7-2 through 11-7-5 of the LaVerkin City code.
- 2.3.3.4 **DURATION OF BOND.** The duration of the bond shall be for one year from the date of approval of the final plat of the subdivision by the City Council. Refer to 11-7-2 of the LaVerkin City Code.
- 2.3.3.5 **FINAL INSPECTION AND PARTIAL RELEASE OF BOND OR DEFAULT.** The Subdivider shall be responsible for the quality of all materials and workmanship of all improvements. No later than one year from the date of approval of the final plat by the City Council, the City Engineer and public works director shall make a preliminary inspection of the improvements and shall submit a report to the City Administrator, setting forth the conditions of such facilities. If the improvements are completed, all liens are paid, and conditions thereof are found to be satisfactory, the City Administrator shall release the bond. If conditions or materials, or workmanship show unusual depreciation or do not comply with the standards of The City in effect at the time of final plat approval, or if any outstanding liens are not

paid, the procedures in subsection F of this section shall be followed. Refer to 11-7-2 11-7-5 of the LaVerkin City Code.

2.3.3.6 FINAL CITY ACCEPTANCE. The Subdivider shall be responsible for the subdivision improvements for a period of one year after said improvements are completed. In accordance therewith, the Ten percent (10%) cash bond, or equivalent as approved, which is retained after completion of the improvements, shall be preserved in escrow by The City for a period of one year to assure that if latent defects or other problems with the improvements are found, whereby the improvements fail to meet city standards, such defects and/or problems are repaired and made to comply with The City Standards. Ninety (90) days prior to the one year anniversary of the date the Ten percent (10%) deposit or bond or security is created, The City Engineer and The Director Of Operations shall again inspect the improvements and shall make a checklist of any needed repairs and a report of the condition of the facilities, which shall then be submitted to The City Administrator. If the improvements are satisfactory at the time of this inspection, the City Administrator shall direct that the Ten percent (10%) deposit, bond, or security retained in escrow shall be released to the Subdivider. If defects or problems are found at this inspection, the procedures in subsection F of this section shall be followed. Once the needed repairs and improvements have been made and are acceptable to The City, and after The City has received all required drawings of record showing any changes to the improvements, The City shall release any remaining deposit or bond or security amount and shall make final acceptance of and assume responsibility for the public streets, public property and The City Infrastructure within the subdivision. Refer to 11-7-2 of the LaVerkin City Code.

2.3.3.7 DEFAULT. If an inspection reveals that the improvements are deficient, the City shall notify the Subdivider that he is in default, and set a reasonable time period, not to exceed ninety (90) days, to correct the problem. At the end of the specified time, the property shall be re-inspected, and if the improvements still fail to meet the required standards and The Subdivider has not submitted to the City and obtained approval of a plan with a deadline to correct the problem, the City Council shall notify The Subdivider of the date a public hearing shall be held on the issue, at which The Subdivider shall be entitled to demonstrate why all or part of his bond should not be forfeited to be used to remedy the problem. The City Council shall decide the matter and issue written findings on the same no later than thirty (30) days after the public hearing. If the City Council's decision after the hearing is that the Subdivider is still in default and no agreement with a deadline between The City and The Subdivider has been made to fix the problem, The City Council may declare his cash deposit or bond or equivalent forfeited, and the City may use the same to repair or install the required improvements. In such case, if the bond is found to be insufficient to cover the reasonable cost of completing or repairing the improvements, the City may enforce the terms of the subdivision improvement cost overrun agreement described in subsection H of this section. Once the needed repairs and improvements have been made and are acceptable to The City, and after The City has received all required drawings of record, The City shall release any remaining bond or equivalent, less twenty five percent (25%) in the case of a bond for original improvements, which twenty five percent (25%) bond shall

be held pursuant to subsection E of this section. Refer to 11-7-1 through 11-7-6 of the LaVerkin City Code.

2.3.3.8 BOND FORFEITURE. In the event a Subdivider and The City enter into an agreement with a deadline for The Subdivider to remedy a problem with the subdivision improvements, if upon inspection by The City it is found that The Subdivider has substantially failed to live up to the terms of said agreement and/or failed to meet the agreed deadline, The City Council may declare his bond to be forfeited and use the proceeds thereof to correct any problem that may exist with said improvements, and may also pursue enforcement of The Subdivision improvement cost overrun agreement if required. No extension of the agreed deadline beyond thirty (30) days shall be allowed. Refer to 11-7-1 through 11-7-6 of the LaVerkin City Code.

2.3.3.9 SUBDIVISION IMPROVEMENT COST OVERRUN AGREEMENT. Prior to or at the time of the obtaining of any bond under this section, the Subdivider shall also sign a subdivision improvement cost overrun agreement, on a form approved by The City. This agreement shall provide that if The City Council declares a bond forfeited under this section, and the bond is found to be insufficient to cover the cost of installing or repairing the improvements, The City may file a lien upon any of the subdivision property owned by The Subdivider, or may otherwise bring legal action pursuant to said agreement against The Subdivider or his properly acknowledged successor, for the difference between the amount of the bond and the cost of installing or repairing the improvements. Said agreement shall provide that the Subdivider shall be responsible for all legal fees and costs of such an action. Refer to 11-7-1 through 11-7-6 of the LaVerkin City code.

2.3.3.10 ABSENCE OF BOND. In the absence of a bond or equivalent, the subdivision plat will not be approved by The City for recordation. Refer to 11-7-1 of the LaVerkin City code.

2.3.3.11 NECESSITY OF REPAIRS: The determination for the necessity of repairs and maintenance of the work shall rest with the City Engineer. His decision regarding 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, all pipes, joints, valves, 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 City Engineer, said work shall be in need of repairs, maintenance, or rebuilding, he shall cause a written or other notice to be served on the responsible party, and thereupon the responsible party shall undertake and complete such repairs, maintenance or rebuilding.

If the party responsible fails to do so within thirty days from the date of the service of such notice, The City Engineer may have such repairs made, and the cost of such repairs shall be paid by the party responsible together with 10% 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 City Engineer, 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 one year before final acceptance. Prior to the end of the one-year warranty 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 City and all appropriate bonds released.

2.3.4 QUALITY CONTROL TESTING. Material testing shall be conducted by an independent testing laboratory approved by The City at The Contractor's expense. 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 City. If determined necessary by the city, 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 City on a weekly basis. 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 certification 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 certification must be on a form approved by The City and certified by a Professional Engineer licensed in the State of Utah.

2.4 DRAWINGS OF RECORD. Construction drawings shall be replaced by a copy of the drawings of record when the project is completed. A complete set of Drawings of Record that includes all items specified in Section 2.2 of these Standards shall be submitted to The City. 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 and in electronic format as an AutoCAD drawing (dwg) file. The version of AutoCAD shall be less than three years outdated (i.e., for the year 2026, version should be AutoCAD 2023 or newer). Improvements and any bond held by The City 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. They shall include a transmittal letter, in duplicate, containing the submittal date, project title, and signature of The Contractor, or The Contractor's Authorized Representative, indicating concurrence by The Contractor. The Developer's Project Engineer shall be responsible for the accuracy of the record drawings and shall include a certificate by the Professional Engineer that each drawing of record is complete and accurate.

2.4.1 ELECTRONIC FILES FOR DRAWINGS OF RECORD. ESRI shapefiles or a geodatabase shall be provided for utilities linework and point locations.

An electronic CAD file (see requirements above) shall be completed and filed with the City for each separate site plan or subdivision development showing the as-built and existing infrastructure pertaining to the project.

Digital files submitted shall meet the following standards:

- o Completed drawing in AutoCAD drawing format (dwg) submitted on a flash drive or external hard drive.
- o File shall be named using the development name (i.e. LaVerkin City_phase_1_DOR.dwg).
- o The file shall include all layers and graphic elements included in the submitted paper document. Graphic elements (title block, legend, scale, etc.) shall be drawn in paper space.
- o Project elements shall be on separate layers with descriptive names, containing only objects that pertain to the layer, and using separate colors (i.e., blue for water, green for sanitary sewer, yellow for storm drains, purple for secondary water, and grey for curb/sidewalks).

- o Numbered layers will be accepted only if accompanied by a text document with full text conversion descriptors (i.e., layer 1= water lines).
- o The drawing shall be PURGED thoroughly of unused layers, blocks, line types, and other material. Remove unwanted objects outside of the project area (Zoom Extents).
- o Drawings shall be labeled and have a GPS point for each object, with labels in model space, which indicate the true location, size, grade, and elevation to an accuracy of 0.1' of all items specified in Section 2.2 of these Standards.
- o Refer to Section 2.2 of these Standards for proper labels and notations.
- o As-built points in the CAD drawing shall be unlocked.
- o The data submittal shall include the following system information as applicable to the project:
 - 1) Roadway System: regulatory signs, street signs, centerlines, curb and gutter, sidewalks, crosswalks, ADA ramps, and monuments.
 - 2) Culinary Water System: fire hydrants, air vacs, water valves, water meters, water laterals, water pipes. Labeled with size, type, hydrant manufacturer, and hydrant manufactured year.
 - 3) Secondary Water System: air vacs, service boxes, valves, water laterals, and water pipes. Labeled with size and type.
 - 4) Sewer System: manholes, laterals, and pipes. Labeled with size, type, main line grade, and elevation at top of the manhole and flowline (in and out).

5) Storm Drain System: catch basins, outlets, manholes, pipes, and detention/retention ponds. Labeled with size, type, main line grade, pond capacity, and elevation at top of manhole or catch basin and flowline (in and out).

6) Parcel Information: boundaries, lots, and public utility easements.

7) Dedicated Land: easements, parks, and trails.

8) Utility Information: streetlights, power sources, wiring plan, future use telecommunications conduit, and service boxes. Labeled with sizes, capacities, and characteristics of all components.

9) As-built GPS survey-grade coordinates of new infrastructure shall also be submitted in a comma-delimited ASCII text file in the following format: Point number, northing, easting, elevation, description. If abbreviated feature codes are used, a feature code legend with full descriptions must be provided. File shall be named using the development name (i.e. The City_phase_1_.csv)

2.4.2 DATA COORDINATE SYSTEM. All drawings and survey coordinates shall be submitted in Utah State Planes; NAD83 datum, South Zone, US Foot coordinates.

2.5 TRAFFIC CONTROL. The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices. All necessary precautions shall be taken to protect the work area and to safeguard the public. Streets closed to traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning 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 will be required for submittal and approval on each project.

2.5.1 GENERAL TRAFFIC CONTROL REQUIREMENTS. The Contractor shall at all times so conduct their work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and protection of persons, property, the 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 channel devices. Traffic cones shall not be permitted as traffic channel devices during the hours of darkness.

Advance warning devices shall be used to alert motorists 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 reflector and lighted, in accordance with the 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 roadways or sidewalks when no longer needed.

A traffic lane should be a minimum of ten feet 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 City's 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 City's Representative, all existing traffic lanes on major streets shall be maintained open to traffic during peak hours, generally from 7:00 AM to 8:30 AM and 4:30 PM to 6:00 PM weekdays.

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 on 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 dust-free as directed by the City's Representative.

Arrangements for partial or complete street closure permits shall be obtained through the City. 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 City'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 ensure that public access and safety are maintained. In general, trenches and excavations shall not be left open or uncovered overnight. Special conditions may be given consideration by the City's Designated 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 City to remove said signs and posts without damage and deliver them to a storage site as directed by the City Representative. When required, the Contractor may need to install temporary signs (i.e., regulatory signs) until such time as permanent signs can be reinstalled. When approved by the City, The Contractor reinstall all traffic signs.

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 City's Representative with a 24-hour emergency phone number of their representative(s) responsible for maintenance of barricades, warning signs, and other traffic control devices.

2.5.2 ROAD CLOSURES. Arrangements for partial or complete street closure permits shall be obtained through the City Representative. An advance notice of forty-eight (48) hours for major streets and twenty-four (24) hours for local streets and alleys is required from the Contractor.

Unless otherwise approved by the City representative, all existing traffic lanes shall be maintained open to traffic.

Local access shall be maintained to all properties on the project at all possible times. When local access cannot be maintained, the Contractor must notify the affected property owner at least twenty-four (24) hours in advance. Access shall be restored on the same day of completion of work which caused the loss of access.

A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt paving if surrounded by or adjacent to existing pavement. Where pavement did not previously exist or where all of the existing pavement has been removed, a traffic lane shall not be considered as satisfactorily open to traffic unless it is graded reasonably smooth and maintained dust-free as directed by the City Representative. 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. (Ord. 2006-23, 7-5-2006)

- 2.6 COOPERATION WITH UTILITIES. The Contractor will notify The City and other private and public utility companies and/or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipelines, 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 the 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 acquaint contact officials of the association relative to the shutdown of irrigation water and shall acquaint them 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 City.

- 2.7 COOPERATION BETWEEN CONTRACTORS. The City 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 City'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 by him 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. They 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 with 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 City'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 City'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 EXPLOSIVES AND BLASTING MATERIALS. The use of explosives or blasting agents is controlled by the International Fire Code (IFC). The Contractor shall obtain a special permit from the Hurricane Valley Fire Department for the use of explosives. A copy of this permit, along with a verbal / written sign-off by all Utilities within that area, shall be delivered to the City's Representative prior to the use of explosives. The approval by The City's Representative for the use of explosives shall not relieve The Contractor from his responsibilities 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. In addition to the applicable regulations, the following requirements shall be adhered to (in any conflict with a permit issued by The Hurricane Valley Fire Department, The Fire Department requirements shall take precedence).

2.9.1 Command, Control, and Permits. The sale, transfer, use, storage, manufacture, or transportation of explosives or blasting materials shall comply with The IFC as adopted and any applicable State or Federal law, rule, or regulation. Required permits shall be obtained from the Department of Public Safety – Fire Division.

When any blasting is to occur within the jurisdiction of any county, city, or municipality, a permit for such activity shall be applied for at least three

working days prior to the desired blasting day. A detailed blast plan shall be submitted for review at the time of application for a permit. The blast plan shall contain the following information:

- o Number of holes per blast.
- o Blast pattern.
- o Depth of holes.
- o Maximum holes per delay.
- o Numbers of the delays used.
- o Type of explosives used.
- o Total pounds of explosives.
- o Maximum pounds per delay.
- o Method of detonation.
- o Proximity to nearest structure.
- o Expected duration of blasting activity.
- o Name of independent monitoring company.
- o Whether or not a pre-blast survey is required, and the name of the company doing such a survey.
- o Plan outline for notification of Fire Marshall, Fire Chief, or governing agency one hour prior to detonation of each blast and approximate time of each blast.

2.9.2 Blasting Criteria. In accordance with United States Bureau of Mines (USBM) Report 8705, two inches per second (IPS) when the

frequencies are greater than fifty hertz (Hz) in any of the three special components in which the data is being collected.

The blaster shall submit with his permit application the projected equative scale distance to be represented by each blast in relationship to the nearest structure. This scale distance shall not be less than fifty. If the scale distance results in a number less than fifty, the blaster will be required to modify the blasting plan in order to produce a safe blast within the above parameters.

Blasting activity that is to occur within one thousand feet of any school (public or private), university, daycare center, church, library, medical facility, or any public building shall be conducted during off hours where possible and shall require seismic monitoring of each blast to insure the integrity of the building as well as the safety of the occupants of said buildings.

Since there is a wide variety in the type density, specific gravity, velocity, and general characteristics within the graphical area of southern Utah, there are varied methods that can be employed to attain the desired results. These methods, if used and however varied, shall adhere to the above limit criteria.

Any blasting that is intended within five hundred feet of any structure (building, tunnel, underground utilities, gas lines, overhead transmission lines, pump station, piping, radio tower, or any other structure of any kind) requires that the blast be monitored with a seismograph capable of measuring peak particle velocities in three special components of horizontal, vertical and transverse and be capable of printing this data into a permanent record as digital as well as wave form and air blast over pressure in terms of millibar, PSI or decibel (dB) recording of each event. Any structure, such as residential homes, commercial buildings, public buildings, storage facilities, or any other permanent structure that is within five hundred feet of blasting activity shall be required to have a pre-blast survey performed at the expense of The Contractor and/or the blaster by an independent company whose primary nature of business is to conduct and perform

these types of services. The said company shall furnish to the authorizing agency a copy of the pre-blast survey report prior to issuance of the blasting permit. A certificate of insurance issued by an underwriter legally doing business within the State of Utah showing the Contractor and/or blaster to be properly insured for the express purpose of blasting and showing the issuing agency as additional insured shall be submitted with the application of the blasting permit. The amount of insurance shown on the certificate of insurance shall be in the amount required by The Hurricane Valley Fire Department or The City's Representative. A blasting permit shall be site-specific and expire thirty days from issuance, unless otherwise extended by the issuing agency.

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

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.

Make a survey of adjacent properties, before commencing blasting operations, locating on drawings and by photographs all existing cracks and damages to structures. A copy shall be filed with The City's Representative, including a report of any Property Owners who refused to cooperate and permit entry and inspection.

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 a congested area or close proximity to any of the above improvements. Steel mats shall not be allowed within two thousand feet of power lines.

At the time of firing, the Contractor shall station certified flaggers along the road at a sufficient distance from the blasting operation to flag down any vehicles.

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

2.9.3 Electric Detonation Method. Electric detonators, if employed, shall be manufactured by a company currently in business. Such detonators shall be used in series and be of twenty-five, fifty, or one hundred milliseconds delay. Millisecond series delay devices for multi-linking larger events may also be used, provided they have been included in the approved blast plan.

2.9.4 Non-Electric Detonation. Several methods of detonation utilizing other than electric detonators or blasting caps are used by the blasting industry. Since, under certain conditions, use of non-electric detonators instead of standard electric caps can be advantageous, they may be used provided they possess delay capability and have been described in the approved blast plan.

2.9.5 Explosives and Accelerants. Based on utilization of forty/sixty percent nitro-based explosives and the utilization of ammonium nitrate-based accelerants, the following limits shall be adhered to:

- o One thousand feet or greater from any structure - a charge no greater than twenty-two and one-half pounds of accelerants and/or explosives per delay.
- o Between five hundred and one thousand feet from any structure - a charge no greater than fifteen pounds of accelerants and/or explosives per delay.
- o Between two hundred fifty and five hundred feet from any structure - a charge no greater than eight and one-half pounds of accelerants and/or explosives per delay.

- o Between one hundred and two hundred fifty feet from any structure - a charge no greater than four and three tenths pounds of accelerants and/or explosives per delay.
- o Under one hundred feet from any structure - a charge no greater than two and one-half pounds of accelerants and/or explosives per delay. No ammonium nitrate-based accelerants may be used within this area.

2.9.6 Notes. Since the purpose of blasting is the break-up and removal of rock utilizing shock waves generated by explosives, it should be understood that these same shock waves travel through the formation, resulting in potential damage to any structure that may be in contact with the same formation. Most of the formations in the geographical area of southern Utah fall into three general categories. Each, generally speaking, has its own specific gravity and resonant velocities with some minor variations. Most of these resonant velocities occur at greater than twelve thousand IPS and at frequencies of greater than fifty Hz. It is therefore necessary to meet or exceed these resonant velocities and frequencies in order to accomplish the desired breakage of the rock.

Although ammonium nitrate-based accelerants provide an inexpensive enhancement to the nitro-based explosives, their velocities are generally well below twelve thousand IPS and produce frequencies under fifty Hz. Therefore, the use of ammonium nitrate-based accelerants within close proximity to existing structures shall not be permitted. As per USBM Report 8707, the greatest potential for structural damage to occur is when the peak particle velocity (PPV) exceeds two IPS with frequencies of less than fifty Hz. Also, the use of these accelerants has a tendency to increase the air blast overpressures and lower frequencies within close proximity to the blast.

2.9.7 Storage and Transportation. Explosives shall be stored in a magazine with separate storage compartments and/or a separate magazine for

the storage and transportation of detonators as per NFSC specifications.

2.9.8 Stemming. Stemming shall consist of three-eighths-inch gravel with a minimum vertical fill dimension of no less than three feet covering each charge. Cuttings, sand, gravel, or any other on-site material will not be accepted when blasting is to occur within five hundred feet of any structure.

2.9.9 Fly rock. Within five hundred feet of any structure, the use of certified blasting mats to cover each charge shall be required. The number of holes per blast shall be limited to the blaster's ability to adequately cover and protect each charge hole. However, no more than fifty-two holes shall be loaded and detonated at any one time when within five hundred feet of any structure.

When within five hundred to one thousand feet of any structure, the blaster shall continue to utilize blasting mats. However, utilization of sand, or other suitable on-site material having an aggregate containing material four inches in diameter or less, can be used as cover for a height of three feet or greater over the top of the existing charge holes. No more than one hundred eighteen holes shall be loaded and detonated at any one time with the five-hundred-to-one-thousand-foot range of any structure.

2.9.10 Logs. Each blaster shall keep a detailed record of each blasting event. Such record shall contain the following information:

- o Depths of holes.
- o The hole pattern or spacing (confined or free face).
- o The total number of holes detonated per event.
- o Number and series of delays used.
- o Method of detonation.

- o Maximum pounds of explosives.
- o Maximum pounds per delay.
- o Maximum pounds of accelerants.
- o Total pounds for the blast.
- o Vertical spacing of decks.
- o Manufacturer and type of blasting agent, accelerants if applicable, and detonation device or devices.
- o The material and depth of stemming.
- o Distance and direction of the blast from the nearest structure and location within the construction site of the blast, i.e., station marker, lot corner, survey marker, and so on.
- o The time of the blast.
- o Name of the blaster and assistants, including address and phone number.
- o Name of seismograph company, if applicable, and resultant seismograph reading with regard to PPV, dB, and FWHz.

The blaster shall, at the request of any authorizing agency, surrender logs or a copy thereof, for review by said agency within twenty-four hours of receiving such request. Failure to keep current and/or surrender the logs to said authority will result in the immediate cancellation of any and all permits issued within the scope of the jurisdiction of these authorizing agencies. No further permits will then be issued within thirty days of submission of said records.

- 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 City, 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 of their manner or method of executing the work, or in consequence of the non-execution thereof by The Contractor, they shall restore, at their expense and at no cost to The City, 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.

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 The City'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. This section sets forth the general standards for survey monuments. Class I or Class II survey control monuments, as shown in the standard drawings of specifications on file in the City, shall be installed on all dedicated and private streets. All survey control monuments shall be installed in strategic locations as determined through the subdivision application process and coordination with the City Engineer to ensure adequate survey control required for proper retracement surveys in the area. Typically, monuments will be located at intersections and at points of

curvature of the centerlines of roadways. Each application will be reviewed for appropriate placement.

A land surveyor, duly licensed in the state of Utah, shall be used to establish the exact location for survey monuments. Said locations shall be platted by said surveyor. Only such registered land surveyor shall be authorized to perpetuate and establish existing Class I survey monuments located within the limits of public or private streets.

All Class I monuments shall be cross-tied and referenced to permanent features. Said features and cross ties shall be mapped sufficiently for future relocation and/or replacement of said monument. All cross-tie information shall be submitted to the City Engineer for approval and will be kept in a permanent record by the City.

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 an appropriate cap as shown in the charts on file in The City. 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 Washington County Surveyors' Office for approval before corners are destroyed. The appropriate public agency surveyors, city or county, shall give direction on requirements for referencing the corner to be replaced and the method of reinstallation before corners are destroyed.

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:

- o All angle points in the survey boundary (Class II).
- o All angle PTs and PCs on and along the survey boundary (Class II).
- o All street centerline intersections (Class I).
- o At a PI outside of the right-of-way (Class II).

1. If PI falls outside the limits of pavement, then PCs and PTs shall be monumented with class I.
 2. If PI falls inside the pavement area, then a Class I monument is required, and no monumentation is required for PCs and Pts.
- o All intersections of street center lines at the survey boundary (Class II).
 - o Six hundred-foot (600') intervals, unless otherwise approved by The City's Representative. If line of sight is not obtainable within a six-hundred-foot (600') interval, then monuments will be required to be closer together unless otherwise approved by The City's Representative.
 - o Class I and II monuments shall be installed in accordance with the City Requirements. 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.
 - o All the above established points, which fall within the limits of public or private rights of way, shall be referenced to four (4) firmly established ties within a radius of twenty feet (20') to one hundred feet (100'). The angle from tie to tie shall be as near ninety degrees (90°) as possible, radiating from the established intersection points. A copy of the survey notes documenting the setting of the reference ties shall be kept by the responsible surveyor, and a copy shall be delivered to the appropriate county surveyor's depository and the City's Representative.
 - o 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 appropriate City Representative for directions and/or requirements.
 - o All monuments shall have a nonferrous cap mounted in accordance with the standard drawings section of these specifications. The surveyor's registration or license number shall be stamped on the nonferrous cap.

- o Monuments must be set prior to the final acceptance of the improvements.
- o Where hard rock or other physical obstructions are encountered, the monument length sufficient to resist removal may vary within reasonable limits. (Ord. 2006-23, 7-5-2006)

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 City's Representative within twenty-four hours.

The written confirmation shall include a statement regarding responsibility to report the discovery to the local health department and the Utah Department of Environmental Response and Remediation within twenty-four hours, as required by Federal Statute (40 CFR 280.50) 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 City 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 City 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 City's Representative.

1. Construction Traffic Control
2. Rough Grading
3. Sanitary Sewer
4. Storm Drainage
5. Culinary Water
6. Electrical Service
7. Telephone
8. Cable TV.
9. Natural Gas
10. Sub Grade
11. Subbase
12. Road Base
13. Curb and Gutter
14. Asphalt and/or Sidewalks
15. Street Signs and Pavement Markings
16. Manhole frames & covers, and valve boxes and covers raised to grade
17. Street lights
18. Survey Monuments
19. 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	68
3.2 STREET DESIGN	68
3.2.1 BASIC STREET CROSS-SECTION STANDARDS	68
3.2.2 HILLSIDE DEVELOPMENT STREET CROSS-SECTION STANDARDS	70
3.2.3 PRIVATE STREET CROSS-SECTION STANDARDS	70
3.2.4 IMPROVEMENTS REQUIRED	70
3.2.4.1 CURB, GUTTER, AND SIDEWALK	70
3.2.4.2 DRIVEWAYS	70
3.2.4.3 PAVEMENT	70
3.2.4.4 STREET LIGHTING	70
3.2.4.5 CROSS GUTTERS	70
3.2.4.6 HANDICAP RAMPS	70
3.2.4.7 MINIMUM ACCESS	71
3.2.4.8 DRAINAGE	71
3.2.4.9 TRAFFIC CONTROL DEVICES	71
3.2.4.10 PAVEMENT MARKINGS	71
3.2.4.11 OTHER IMPROVEMENTS	72
3.2.5 TECHNICAL DESIGN REQUIREMENTS	72
3.2.5.1 STREET GRADES	72
3.2.5.2 INTERSECTIONS	73
3.2.5.3 INTERSECTION SPACING	74
3.2.5.4 MAXIMUM DESIGN VOLUME	75
3.2.5.5 CUL-DE-SAC STREETS	76
3.2.5.6 CURB AND GUTTER	76
3.2.5.7 MAXIMUM DESIGN VOLUME	76
3.2.5.8 DESIGN SPEED	77
3.2.5.9 CLEAR SIGHT DISTANCE AT INTERSECTIONS	78
3.2.5.10 VERTICAL ALIGNMENT	78
3.2.5.11 SAFE STOPPING SIGHT DISTANCE	79
3.2.5.12 HORIZONTAL CURVES	80
3.2.5.13 SUPERELEVATION	80
3.2.5.14 DECELERATION LANES	80
3.2.5.15 DRIVEWAY PROFILES	81
3.2.5.16 ALIGNMENT AND CONTINUITY OFFSITE	82
3.2.6 PAVEMENT STRUCTURAL DESIGN	84
3.2.7 CURBSIDE MAILBOXES	86

3.2.8 STREET SIGNS AND PAVEMENT MARKINGS	86
3.2.8.1 PAVEMENT MARKINGS	87
3.2.9 UNDERGROUND WATER	87
3.3 SOIL STUDY GUIDELINES	87
3.4 DRAINAGE AND FLOOD CONTROL DESIGN	87
3.4.1 GENERAL REQUIREMENTS	87
3.4.2 DESIGN CRITERIA – STREETS	90
3.4.3 DESIGN CRITERIA – STORM DRAIN	91
3.4.4 DESIGN CRITERIA – CULVERTS	91
3.4.5 DESIGN CRITERIA – BRIDGES	92
3.4.6 DESIGN CRITERIA – CHANNELS	93
3.4.6.1 OPEN CHANNELS	93
3.4.6.2 MAN-MADE CHANNELS	94
3.4.6.3 NATURAL CHANNELS	94
3.4.7 STORAGE FACILITIES	95
3.4.7.1 DESIGN CRITERIA – STORAGE FACILITIES	96
3.4.8 FLOOD PLAINS	97
3.4.8.1 DESIGN CRITERIA – FLOOD PLAINS	97
3.4.9 EROSION CONTROL	98
3.5 SANITARY SEWER DESIGN	98
3.5.1 UTILITY CLEARANCES	98
3.6 CULINARY WATER DESIGN	99
3.6.1 DESIGN FLOW PRESSURE	99
3.6.2 FLOW DESIGN CRITERIA	100
3.6.2.1 PEAK INSTANTANEOUS FLOW	100
3.6.3 MINIMUM SIZE AND DEPTH	101
3.6.4 VALVES AND HYDRANTS	101
3.6.5 PRESSURE REDUCING VALVES	102
3.6.6 FIRE HYDRANT SPACING AND LOCATION	102
3.6.7 FIRE FLOW REQUIREMENTS	103
3.6.8 MISCELLANEOUS WATER SYSTEM DESIGN CRITERIA	103
3.6.8.1 ALL PUBLIC WATER MAINS	103
3.6.8.2 DEAD-END MAINS	104
3.6.8.3 SEPARATE WATER LINES AND METERS	104
3.6.8.4 SERVICE LINE TAPS	104
3.6.8.5 VERTICAL SPACING	104

3.6.8.7 THRUST RESTRAINTS AND THRUST BLOCKS	105
3.6.8.8 AIR RELEASE VACUUM ASSEMBLIES	105
3.6.8.9 TRACER WIRE	105
3.6.8.10 SUFFICIENT VALVES	105
3.6.9 NETWORK HYDRAULIC ANALYSIS	106
3.6.9.1 DESIGN	106
3.6.9.2 SUBMITTAL FOR REVIEW AND APPROVAL	106
3.6.9.3 MISCELLANEOUS	107
3.6.10 BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL	108
3.7 SECONDARY WATER OR WASTEWATER REUSE IRRIGATION SYSTEM	109
3.7.1 SECONDARY SYSTEM INSTALLATION	109
3.8 OTHER UTILITIES SYSTEMS DESIGN	110
3.8.1 RESPONSIBILITY	110
3.8.2 STREET LIGHTS	110
3.8.2.1 SIDE STREET (LOCAL STREET)	110
3.8.2.2 HIGHWAY (COLLECTOR STREET)	110
3.8.3 BURIAL OF LINES	110
3.8.4 LAYOUT	111
3.8.5 FRONT LOT LINE SYSTEMS	111
3.8.6 QUALITY CONTROL	111
3.9 TRAFFIC STANDARDS	111
3.9.1 ACCESS CONTROL	111
3.9.2 TRAFFIC IMPACT STUDIES	112
3.9.2.1 WHEN REQUIRED	112
3.9.2.2 INITIAL WORK ACTIVITY	113
3.9.2.3 QUALIFICATIONS FOR PREPARING TIS DOCUMENTS	115
3.9.2.4 ANALYSIS APPROACH AND METHODS	115
3.9.3 STUDY AND REPORT FORMAT	120
3.10 SURVEY MONUMENTS STANDARDS	124
3.10.1 GENERAL REQUIREMENTS	124
3.10.2 MONUMENTS	124
3.10.3 TYPES OF MONUMENTS	126
3.11 DEFINITIONS	126

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. As determined by the City Engineer, all existing improvements related to the project or within the boundaries of the project shall be brought up to current standards.

These standards are the minimum required and should be considered as such.

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.

- 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 shall be used as a supplement to these guidelines. In cases of conflict, a determination shall be made by The City, which determinations shall be final.

3.2.1. BASIC STREET CROSS-SECTION STANDARDS. Basic Street Cross Section Standards Requirements are detailed below in Table 3.2.1 and shown in the standard drawings. Alternate road cross sections may be used, if applicable safety and traffic standards are met and approved by the City Engineer.

TABLE 3.2.1
STREET DESIGN STANDARDS

STREET TYPE	MAX. GRADE	MIN C. L. RADIUS	WIDTH (IN FEET)			CURB & GUTTER	
			RIGHT OF WAY	PAVEMENT (1)	SIDE-WALK (1)(3)	TYPE (2)	MIN. RAD.
LOCAL	10	100	50	33	5	See Detail	20
COLLECTOR	10	300	60	43	5	See Detail	20
MAJOR	10	400	60	46	5	See Detail	25
ARTERIAL	8	600	100	76	8	See Detail	40

Notes for Table 3.2.1:

- 1) In industrial and manufacturing areas, road pavement may be widened 10 feet in lieu of concrete sidewalks as approved by the City Engineer.
- 2) Areas of high-water flow may require larger curb and gutter capacity than shown.
- 3) Sidewalks adjacent to State Street shall be ten foot in width. Sidewalks in other areas of high pedestrian traffic may require greater width as determined by the City Engineer.

3.2.2 HILLSIDE DEVELOPMENT STREET CROSS-SECTION STANDARDS. Refer to Chapter 7A of the City code.

3.2.3 PRIVATE STREET CROSS-SECTION STANDARDS. Refer to 10-7-13 of the City code.

3.2.4 IMPROVEMENTS REQUIRED.

- 3.2.4.1 CURB, GUTTER, AND SIDEWALK. Required curb, gutter, and sidewalk shall be constructed in accordance with the standard drawings and these specifications
- 3.2.4.2 DRIVEWAYS. Driveways shall be constructed in accordance with the standard drawings.
- 3.2.4.3 PAVEMENT. All streets, public or private, shall be surfaced to grade, with asphalt pavement, to the minimum width and thickness in accordance with standard drawings and these specifications.
- 3.2.4.4 STREET LIGHTING. Street lighting shall be provided on all public streets. The construction shall be in accordance with the standard drawings and specifications of Rocky Mountain Power.
- 3.2.4.5 CROSS GUTTERS. No cross gutters shall be allowed across major collector or minor and major arterial streets. When constructed on other streets, they shall be constructed in accordance with the standard drawings. The City Engineer may, with justification, prohibit construction on streets other than collector or arterials.
- 3.2.4.6 HANDICAP RAMPS. When new construction occurs, handicap ramps shall be constructed at all street intersections, in accordance with the most current ADA standards. In addition, when a project occurs where existing improvements are in place, handicap ramps shall be upgraded to meet current standards.
- 3.2.4.7 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.

- 3.2.4.8 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 the approved drainage study. Cross gutters shall be used sparingly to maintain the public's driving comfort and in accordance with these specifications

Drainage facilities shall be designed to convey the 10-year storm in storm drain culverts. The 100-year storm shall be conveyed in the culverts and the street. The hydraulic grade line (HGL) for the 10-year storm event shall be shown on the storm drain profiles. Profiles shall be included for every storm drain culvert in a proposed project.

Drainage discharge shall be limited to the lesser of predevelopment flows or 0.2 cubic feet per second per acre. Refer to the drainage manual and drainage master plan for more information.

- 3.2.4.9 TRAFFIC CONTROL DEVICES Appropriate traffic control devices and street signs, as required by the City Engineer, shall be installed in accordance with the MUTCD.
- 3.2.4.10 PAVEMENT MARKINGS. Appropriate pavement markings, as required by the City, shall be installed in accordance with the MUTCD.
- 3.2.4.11 OTHER IMPROVEMENTS. The above-mentioned 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 City Engineer.

3.2.5 TECHNICAL DESIGN REQUIREMENTS. The following requirements apply to public and private streets.

3.2.5.1 STREET GRADES All street grades shall have a maximum of ten percent (10%). Minimum grade shall be 0.5 percent unless approved by the City Engineer.

Maximum street grades may be increased to twelve percent (12%) upon prior approval of the LaVerkin City Council. Approval may be given based upon evaluation of evidence submitted, which shows a smaller amount of disturbance to the existing terrain if larger percentages are used and result in no significant decrease in safety features. Any approvals for increased grades must be consistent with the access requirements of fire apparatus as defined by the Hurricane Valley Fire Department.

Approval may be given based upon evaluation of evidence submitted, which shows a smaller amount of disturbance to the existing terrain if larger percentages are used and result in no significant decrease in safety features.

Any approvals for increased grades must be consistent with the access requirements of fire apparatus as defined by the Hurricane Valley Fire Department.

3.2.5.2 INTERSECTIONS

- o All street intersections should intersect at ninety-degree angles.

- o In the event an acute angle intersection is required by the City's Representative may require mitigation by realigning to achieve a ninety-degree intersection. At a minimum, this can be accomplished by the use of a fifty-foot section prior to the P.C. of the curve or a landing area design in which a vehicle is brought ninety degrees to the intersecting road. Other design approaches to mitigate the acute angle may be required by The City.
- o Intersections should not be located on or near sharp curves, i.e., curves with radii close to AASHTO minimums. Intersections should be located sufficient distance from all curves to provide proper sight distance for vehicles on the intersecting road or driveway and on the through road.
- o New intersections with more than four "legs" are not permitted. For arterial access, only four-leg and "T" intersections are permitted. When designing local road networks, "T" and "L" intersections are desired. The "L" intersection will only be permitted when the street length, in either direction from the angle point, is three hundred feet, or less. Four-leg intersections on local road networks are permitted but not encouraged. Previous approval for four-leg intersections shall be obtained prior to final design of the road network. Exceptions to these requirements may be granted by The City on a case-by-case basis. The developer must provide compelling justification before deviations will be granted.
- o When designing local road networks, block lengths without an intervening connector street shall not exceed eight hundred feet in length unless previous approval has been obtained from The City's Representative. Cul-de-sacs are not included in this requirement.

- o New access locations created by development shall be unified whenever possible to create the fewest number of access points onto arterials or major collectors.
- o Access to corner lots should be from the lesser-classified road, at the greatest distance possible from the intersection.
- o Direct access will not be allowed for parking, loading or driveway areas that require backing maneuvers onto arterial streets.
- o Residential and commercial developments of 50 homes or more shall require at least two accesses per the Hurricane Valley Fire Department. The accesses shall be of proper widths to accommodate the calculated traffic volumes when the area is fully developed. Projected traffic volumes shall be calculated using the criteria outlined within the Traffic Impact Study requirements of these specifications.
- o No covered driveways will be allowed unless approved by the City's Representative.

3.2.5.3. INTERSECTION SPACING: Intersections (whether street or driveways) shall be spaced far enough apart so that the traffic stopped to make left turns at one intersection does not interfere with traffic movements at the adjacent intersection.

On low-volume streets, the minimum distance is one hundred fifty feet; for the minor and major collector streets, the minimum distance is two hundred fifty feet. Minimum distance measurements are centerline-to-centerline. The minimum spacing requirement on arterials shall be based upon current and projected turning movement volumes at the intersections in question. The City's Representative shall

review and give final approval to any intersection requests on arterials in which the spacing would be less than four hundred feet apart.

Driveway Spacing: Driveways shall be spaced far enough apart so that the traffic stopped to make left turns at one intersection does not interfere with traffic movements at the adjacent intersection.

3.2.5.4 MAXIMUM DESIGN VOLUME:

- o The maximum design volume shown on Table 3.2.2 may be increased to the values shown below upon prior approval by The City's Representative.

Maximum Design Volume

Minor Collector	-	3,000
Local	-	1,250
Hillside Local	-	1,000

The conditions which must be considered when approving an increase in maximum design volume are:

- o Degree of hillside disruptions when comparing two street circulation systems based upon use of the different maximum design volumes shown in Table 3.2.2 and above.
- o An affirmative finding that the traffic safety on the streets in question will not be adversely affected and such finding is approved by the City.

3.2.5.5 CUL-DE-SAC STREETS. Such streets shall not exceed six hundred feet in length from the center of the cross street to

the center of the cul-de-sac. The turnaround radius (at property line) shall not be less than fifty feet.

3.2.5.6 CURB AND GUTTER:

- o High Water Flows: Areas of high-water flow may require larger gutter capacity than shown on the standard drawing. High back (HB30-7) or wedge back curb (RU30) may be used in accordance with standard drawings and with directions from the City Representative. Sidewalk depth shall be at least six inches (6") for modified wedge curb and 4" for high back curb.
- o Curb Corners: All curb corners shall have a radius of not less than fifteen feet (15'); at intersections involving collectors or major streets, of not less than twenty-five feet (25'); in industrial areas, not less than twenty-five feet (25').

3.2.5.7 MAXIMUM DESIGN VOLUME:

- o The maximum design volume shown on Table 3.2.2 shall be used unless Conditions which must be considered when reviewing a request for an increase in maximum design volume, including hillsides, safety, parking, traffic studies, access requirements, etc.

TABLE 3.2.2 STREET CROSS-SECTION STANDARDS

STREET CLASSIFICATION	ADT6
MINOR COLLECTOR	1,500-2,500
LOCAL ROAD	750-1,000
HILLSIDE LOCAL	150-750
HILLSIDE ACCESS	0-150

3.2.5.8 DESIGN SPEED:

- o 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 City Engineer, who may decide that the speed provided in this section be reduced to that which is reasonable and prudent under the conditions and having due regard to the actual and potential hazards.

Design Speed

Classification	Design
Local	25
Minor Collector	35
Major Collector	35-40
Minor Arterial	40-45
*Major Arterial	(45 min)

*Variance of design speeds on residential collectors or higher order roads may be granted by the City Engineer 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.

3.2.5.9 CLEAR SIGHT DISTANCE AT INTERSECTIONS:

- o 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:

Clear Sight Distance at Intersection

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

*Sight distances shall be adjusted with crossroad grades

3.2.5.10 VERTICAL ALIGNMENT:

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

- o Longitudinal street grades shall not be less than one-half percent, nor more than (10) percent, unless specifically approved by the City Engineer.
- o 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.
- o Minimum cross slope from street crown shall be two percent, and the maximum four percent unless otherwise approved by the City Engineer.
- o 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 City Engineer.

3.2.5.11 SAFE STOPPING SIGHT DISTANCE:

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 shall comply with the requirements set forth below (AASHTO guidelines):

Safe Stopping Distance

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

3.2.5.12 HORIZONTAL CURVES:

- o The recommended minimum centerline radius for horizontal curves is outlined below:

Horizontal Curves

Design Speed	Require Distance
25 MPH	195*
30 MPH	333
35 MPH	510
40 MPH	762
45 MPH	1039
50 MPH	926

* For residential streets, use 150.

3.2.5.13 SUPER ELEVATION. The use of superelevation shall require prior approval from the City Engineer.

3.2.5.14 DECELERATION LANES 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 the following factors are determined to apply:

- o 5,000 vehicles per day are using or are projected to be use, the street.
- o The 85th percentile traffic speed on the street is thirty-five miles per hour or greater; or forty miles per hour for a two lane (one lane each direction) roadway; and

Fifty 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 City Engineer. In addition to the above guidelines, deceleration lanes may be required in connection with the results of a Traffic Impact Study or by the City Engineer.

3.2.5.15 DRIVEWAY PROFILES.

- o 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.

Required treatments of driveway grades are shown below. In commercial use, while eight percent (8%) should be the maximum allowable initial grade, maximum grades of three percent (3%) are preferable for high-volume driveways and six percent (6%) for low-volume driveways. For driveways that require steeper grades an engineered design is recommended.

Driveway Profile

Driveway Type and Adjacent Street Classification	Maximum Grade
Low Volume Driveway** on Local Street	10%

Low Volume Driveway** on Collector Street	10%
Low Volume Drive** on Arterial Street	5%
High Volume Driveway*** on Any Street	5%
* For single family residential homes these values apply to only the initial 10 ft. of the driveway beyond the sidewalk or right-of-way, whichever applies. ** 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.	
The above requirements apply only to driveways that adjoin public streets and are recommended for those adjoining private streets.	
For grade changes greater than 12%, a vertical curve of at least 10 ft. should be used to connect the tangents.	

3.2.5.16 ALIGNMENT AND CONTINUITY OFF-SITE:

- o Normally, off-site pavement construction requires asphalt concrete paving to the right-of-way centerline and in some cases beyond.

When there is existing asphalt pavement, the developer's engineer shall submit to the City Engineer 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-seven feet (27), or to the center line, whichever is greater, of

paving to accommodate through traffic. Required parking and shoulders are not included in the 27 feet. 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 shall be placed at each end of the improvements. Horizontal transition tapers shall be designed and constructed off-site based upon the 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 City Engineer.

- o 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.
- o Wherever partial street construction is required, grades shall be set for the future curb line and approved by the City's Representative. The future grades shall be compatible with the curb and centerline grades for the partial street construction.

It may be necessary 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.

- o 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.

3.2.6 PAVEMENT STRUCTURAL DESIGN:

- o 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 City Engineer.

The geotechnical investigation shall be conducted by The Geotechnical Engineer. The investigation shall include a thorough exploration and sampling program of the sub grade 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:

Sampling Program of The Sub grade

A). Excavate test holes to a minimum depth of five feet below subgrade. There shall be three test holes for the first one thousand (1000) feet and one for every eight hundred (800) feet thereafter, or as soil type varies.
B). Calculate "R" values using AASHTO T 190-93 or ASTM D2844-69 using exudation pressure of 300 PSI (2070 Kpa) corrected to 2.50 inches (63.50 mm) specimen. Calculate "CBR" values using AASHTO T 193-93 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 T193-93. Minimum Testing Frequency for "R" or "CBR" values shall be as follows:
C). Two tests with at least one test per significant soil type for roadway lengths of one foot to one thousand feet.
D). Three tests with at least one test per significant soil type for roadway lengths of one thousand feet to five thousand feet.
E). Four tests with at least one test per significant soil type for roadway lengths of five thousand feet to sixteen thousand feet.
F). Two tests per five thousand feet of roadway with at least one per significant soil type for any roadway over sixteen thousand feet.
G). Conduct sieve analysis using either AASHTO T27-91 or ASTM C136-95. Conduct a sand equivalent test to determine the presence or absence of plastic fine material using either AASHTO T176-86(1993) 4.3.2 alternate method No. 2, pre-wet 4.3.3 mechanical shaker or ASTM D2419-91 9.4.2 Procedure B, 11.6.1 mechanical shaker. Either method shall use distilled or demineralized water for the working solution. One test for each stratum of each test hole
H). Solubility test shall be performed on all materials used for any structure pavement design.
I). Calculate density in place using the drive-cylinder method ASTM D2937- 83 or nuclear method ASTM D2922-93.
J). Two tests per test hole.
K). Calculate resistivity and pH using test methods AASHTO T-288-91 and AASHTO T-289-91.
L). One test for each corrugated metal pipe culvert location. Expansion index of soils shall be determined using the ASTM D4829-88 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 City'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 46 location. In this case the new development shall match the existing roadway location.

3.2.7 CURBSIDE MAILBOXES. All roadside mailboxes 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. Additional easements may be required depending on the location of the boxes. The developer shall be responsible for the purchase and installation of all mailboxes (under the direction of the Local Postmaster) in new developments.

3.2.8 STREET SIGNS AND PAVEMENT MARKINGS: Signing Materials, Fabrication and Placement: All street name signage shall follow the requirements for materials, fabrication, and installation outlined in the MUTCD, standard drawings, and these specifications:

- o Street name sign face materials shall consist of reflective high intensity grade sheeting. The sign face colors shall conform to the local requirements for public and private streets. The street name sign blank shall consist of high tensile degreased aluminum in accordance with the standard drawings.
- o 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.

- o All advisory and regulatory traffic signing shall conform to the requirements relating to color, face material, blank material, size, and method of installation as found in the MUTCD for streets and highways.
- o All street name, advisory, and regulatory signing shall be installed in such a manner as to provide adequate advance visibility for an approaching driver.

3.2.8.1 PAVEMENT MARKINGS. See Section 5 of these Standards.

3.2.9 UNDERGROUND WATER: When underground water in or adjacent to the site is encountered by geotechnical investigation or during the construction work, the City'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. Do not ignore the situation!

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

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

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 City that requires a grading permit or exceeds one acre in area, and all commercial

development, shall submit a Drainage Control Plan, SWPPP Report, prepared by a Utah Registered Professional Engineer.

Design of drainage systems associated with development shall not cause increases in the lesser of 0.20 cubic feet per second per acre, or flood peak discharges downstream from the development for 10-year and 100-year flood events.

All drainage plans shall conform to the requirements of these standards and be approved by the City Engineer or his designee.

Drainage and flood control plans shall be designed to conform to the latest update of the City's Storm Drain Master Plan.

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

In general, each development should handle its stormwater runoff in such a manner that no increase in the 10 or 100-year peak storm runoff above the pre-development and/or natural state will occur on downstream properties. In no case shall discharge exceed 0.20 cubic feet per second per acre.

Profiles shall be included in all construction drawings for the installation of storm drains and open channels. The hydraulic grade line (HGL) shall be shown on the profiles for the 100-year storm.

In general, development changes the characteristic (quantity) of drainage from sheet flow to point discharge flow. While the amount 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 analyzed, designed, and constructed to protect the development from the 100-year peak storm runoff. Most drainage collection system capacities for new development will be

sized for the 10-year flood event, but no significant damage or risk of personal injury may occur from the 100-year flood. Major hydraulic structures (including bridges, large culverts, and open channels) will be designed for the 100-year flood.

For analysis purposes of the drainage system of a drainage basin area, all the drainage basins upstream of the proposed development should be analyzed for the conditions of new and/or planned development in conformance with the City's current Land Use Master Plan. Effects on downstream property owners and 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 City Engineer 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.

New development should not cause a natural drainage channel to be filled in, obstructed, or diverted. When modifications to a natural drainage channel is 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 City Engineer 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 City.

The point where the natural drainage channel enters and leaves the property will not be changed without approval of the City Engineer.

Improvements designed to protect development shall be considered permanent and shall be designed and constructed accordingly. Such improvements shall be easily maintained by the maintaining agency.

New development shall provide the necessary means to ensure drainage within the property being developed, makes use of existing facilities and/or natural washes, and shall be required to construct master planned improvements. Streets are a significant and important component in urban drainage and shall be made use of in storm runoff within reasonable limits. The primary purpose of streets is for traffic. Reasonable limits for the use of streets for runoff shall be set by the City Engineer.

When drainage encroaches beyond that allowed for in the streets or point discharges are exceeded, an independent storm water system shall be designed and constructed by new development.

3.4.2 DESIGN CRITERIA - STREETS. Design criteria for gutter capacity and associated lane flooding will depend on roadway type as shown in Table 3.3. Street designs must include surface drainage relief points (especially for flat gradient areas, local sumps or depressions, and downhill cul-de-sacs) and provide for routing of one-hundred-year recurrence hydro graphs to adequate downstream conveyance facilities. For pedestrian safety, one-hundred-year flood flow in streets must be limited by underground storm drain conveyance and street design so that the product of depth (ft) and velocity (ft/sec) in gutter does not exceed six. One-hundred-year flood flows in streets must be contained within the street right-of-way and adjacent drainage easements. Where underground conveyance is required to limit street flows, it will be designed for the ten-year flood or greater.

TABLE 3.3
Street Gutter Capacity for 100-Year Event

Local's	Flow may spread to crown
Minor Collector & Residential Collector	Flow may spread to crown
Collector & Major Collector	Flow spread must leave one travel lane free of water

Arterial	Flow spread must leave one travel lane and Center turn lane Direction free of water
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- 3.4.3 DESIGN CRITERIA - STORM DRAINS. Storm drain design conveyance capacity will be sized for a minimum of the ten-year, three-hour flood. The one-hundred-year, three-hour design flood will be used for evaluation and prevention of significant damage due to street overflow. Inlets must have sufficient capacity to prevent local ponding in the ten-year event, with fifty percent flocking of inlets by debris. Analysis of combined street and storm drain capacity for the one-hundred-year flood must determine maximum ponding depths and water levels, and show that these are non-damaging.

Design consideration will be given for differences in interception capacity of inlets on grade compared to interception capacity of inlets in sag locations. Inlet spacing and locations will be for continuous grade or sag situations, as appropriate.

All storm drains will be designed by application of the Manning equation. Minimum velocity shall be two ft/sec flowing one-half full.

Storm drains will not be allowed to be designed for surcharged pipe conditions unless otherwise approved by the City.

When storm drains are designed for full pipe flow, or surcharged pipe conditions, the designer shall establish the hydraulic grade line considering head losses caused by flow resistance in the pipe, and changes of momentum and interference at junctions, bends and structures. The water surface elevation profile and hydraulic grade line will be shown for the ten-year and one-hundred-year design flood as required in the Drainage Control Report and Plan.

- 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 24". All culvert crossings under a roadway shall be designed to handle the 100-

year storm (see Section 3.4. 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 percent (50%) shall be used for small diameter culverts and culverts placed in drainages with upstream debris, as determined by The City. The one-hundred-year design storm water backwater surface upstream will be determined using an approved method (generally a HEC-2 or HEC-RAS) unless otherwise not required by The City. The backwater must be shown to be non-damaging and be approved by the affected property owner. Potential paths of embankment overtopping flows will be determined and redirected, if necessary, so that no significant flood damage occurs. Entrance and exit structures must be installed to minimize erosion and maintenance. The minimum culvert slope shall be one percent (1%) unless otherwise approved.

3.4.5 DESIGN CRITERIA - BRIDGES. Bridges consist of major structures carrying major washes or drainages. 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 bridges, and others.

Free-span bridges must pass the one-hundred-year event with a minimum of two feet of freeboard. No significant increases are allowed in upstream water levels. An approved method (generally a HEC-2 or HEC-RAS) of potential upstream water surface may be required by the City. Local and regional scour analysis is required on the structure, upstream and downstream, and embankments. All potential scour will be mitigated. Appropriate references for this are Stream Stability at Highway Structures, Hydraulic Engineering Circular No. 20, Federal Highway Administration, and computer programs such as USCOE HEC-6 or FHWA FESWMS.

For structures crossing FEMA-designated flood plains and drainages, other requirements will be used; consult the City Engineer.

3.4.6 DESIGN CRITERIA - CHANNELS.

3.4.6.1 OPEN CHANNELS. Generally, there are two types of channels: man-made and natural. Natural channels can be further subdivided into several subcategories, such as un-encroached, encroached, partially encroached, bank-lined, and others. The one-hundred-year recurrence flood will be used for design for all channels unless otherwise approved by the City. All open channels must be designed as permanent in nature and have a minimum freeboard of one (1) foot. They must be designed as generally low-maintenance facilities and must have adequate access for the entire length.

TABLE 3.4 OPEN CHANNEL DESIGN CRITERIA

Material/Lining	Permissible Velocity
Natural and Improved Unlined Channels	
Fine sand, colloidal	1.50
Sandy loam, noncolloidal	1.75
Silt loam, noncolloidal	2.00
Alluvial silts, noncolloidal	2.00
Ordinary firm loam	2.50
Volcanic ash	2.50
Stiff clay, very colloidal	3.75
Alluvial silts, colloidal	3.75
Shales and hardpans	6.00
Fine gravel	2.50
Graded loam to cobbles when noncolloidal	3.75
Course gravel, noncolloidal	4.00
Cobbles and shingles	5.00
Sandy silt	2.00
Silty clay	2.50

Clay	6.00
Poor sedimentary rock	10.00
Fully Lined Channels	
Unreinforced vegetation	5.00
Loose riprap	10.00
Grouted riprap	15.00
Gabions	15.00
Soil-Cement	15.00
Concrete	35.00

- 3.4.6.2 MAN-MADE CHANNELS. Man-made channel side slopes will generally be limited to a maximum slope of 2H: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 a steeper slope. 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 design may be required to limit velocities to control erosion and head cutting.

Maximum velocities for grass lined channels depend on the type(s) of grass mixtures. The designers should consult appropriate design literature for details. It is assumed that grass lined channels will be mowed at least annually. The minimum bottom width of a grass lined channel will be 6 feet unless otherwise approved by the maintenance agency. The minimum bottom width of all manmade channels shall be designed to facilitate access and maintenance.

- 3.4.6.3 NATURAL CHANNELS. 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 due to improvements to upstream drainage basins and areas, adequate access for maintenance and debris removal, long-term degradation and erosion potential, and the need for additional setbacks for structures.

NOTES:

- For composite-lined channels, use the lowest of the maximum mean velocities for the materials used in the composite lining.
- Deviations from the above values are only allowed with appropriate engineering analysis and/or suitable agreements for maintenance responsibilities.
- Reference: Natural-Fortier and Scobey, 1926, Fully Lined-Various Sources

Maximum velocities for grass-lined channels depend on type of grass mixtures, with higher velocities appropriate for Bermuda grass.

Consult Open-channel Hydraulics, Ven Te Chow, for details. The minimum bottom width of the channels will be six feet to facilitate access of maintenance equipment.

3.4.7 DESIGN CRITERIA - STORAGE FACILITIES. Generally, there are two types of storage: retention and detention. Retention ponds, which are normally intended for infiltration of stored water, may require extensive subsoil and groundwater studies as well as extensive maintenance requirements and safety concerns. Retention ponds are not allowed unless approved by The City Engineer. 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 limited downstream capacity, as in regional basins, or on a limit on the increase either limited downstream capacity, as in regional basins, or on a limit on the increase in flows over pre-development conditions, as in local facilities, and in some instances, both.

Regional detention facilities are those identified by The City and will be identified in the Master Storm Drain Study and other regional 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 ten-year, seventy-two-hour and the one-hundred-year, seventy-two-hour peak flows, or the one-hundred-year three-hour storm, whichever case requires the largest volume. Post-development discharges must not exceed the lesser of pre-development flows or 0.20 cubic feet per second per acre. If downstream facilities lack adequate capacity to handle the flow, other release rates must be used.

Standard 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. Emergency spillways or overflows 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 basin should be 3 feet unless otherwise approved. 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. Groundwater should not be introduced into detention basins.

Energy dissipation and erosion protection is required at all outlet structures where storm drainage is released into a natural or erodible channel, unless otherwise approved by The City. 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 City.

3.4.8 FLOOD PLAINS: Flood plains are generally classified as FEMA (FEMA stands for Federal Emergency Management Agency) and non-FEMA. Any work in and around FEMA-designated and mapped floodplains should refer to the FEMA standards governing their use. All work in the FEMA floodplain requires an appropriate permit.

3.4.8.1 DESIGN CRITERIA-FLOOD PLAINS. Building floor levels shall be constructed a minimum of two feet above the one-hundred-year FEMA and non-FEMA flood level, unless otherwise approved by the City. Encroachment within the one-hundred-year flood plain for FEMA and non-FEMA natural water courses will not be permitted without HEC-2

hydraulic studies as directed by the City. All-natural drainages, washes, and waterways that convey a developed one-hundred-year flow of one hundred cfs or more shall be left open and undisturbed, unless otherwise approved by The City. Any alteration of FEMA flood ways is not permitted unless the proposed use can be shown to have no negative influence on flood conveyance.

3.4.9 EROSION CONTROL. Necessary measures shall be taken to prevent drainage erosion at times during the construction of new developments. During grading and construction, the developer shall control all potential storm runoff so that eroded soil or debris cannot enter any downstream water course or adjoining property. An approved SWPPP permit will be required.

3.5 SANITARY SEWER DESIGN. All Sanitary Sewer installed within the City shall meet the requirements of the Ash Creek Special Service District.

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

- o Utility clearances specified in applicable laws and codes shall be adhered to.
- o Sewer mains should be placed lower than other utilities.
- o Water distribution and sewage collection lines shall be laid in separate trenches, with at least ten (10) feet of separation measured horizontally.
- o 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, refer to Ash Creek's requirements

- o Sewer laterals and mains crossing under power, storm drain, telephone, traffic signal conduit, and/or street lighting conduit shall have at least one (1) foot separation measured vertically. The clearance for gas lines shall be five (5) feet. If the required vertical clearance cannot be met as determined by the City Representative, a cushion of sand and cement slurry may be used to separate the utilities. Where use of sand and cement slurry are not practical, the Engineer may propose alternate methods.
- o The following clearances should be maintained between culinary waterlines and other utilities.

Utility Clearances

Water to phone lines/cable TV	five (5) feet
Gas to water	five (5) feet
Water to power	five (5) feet
Water to irrigation	two (2) feet
Water to wastewater	ten (10) feet horizontal and eighteen (18) inches vertical.
Gas to power	ten (10) feet.
Water to Water	three (3) feet

3.6 CULINARY WATER DESIGN. All culinary water mains and appurtenances within The City 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. Trunk lines shall be designed in accordance with the system master plan.

3.6.1 DESIGN FLOW PRESSURE. Water mains shall be designed to provide minimum water pressure as required by the Utah Administrative Code R309-105-9. This includes a minimum residual pressure of thirty (30) psi under peak instantaneous demand conditions, a minimum of twenty (20) psi during conditions of fire flow (See Section 3.6.7 of these standards), and a minimum of forty (40) psi residual pressure must be maintained under normal peak day conditions without fire flow.

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 R309. 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. Peak instantaneous flow for outdoor use shall be assumed as follows: Indoor Peak Instantaneous Flow multiplied by two. Peak instantaneous fire flows shall be added to peak instantaneous domestic flows for distribution system design flow total.

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 City Engineer.

3.6.2.1 PEAK INSTANTANEOUS FLOW.

Peak instantaneous flow, as defined by the State of Utah Public Drinking Water Regulations, shall be as follows:

Residential (indoor use -- not including fire flow):

$$Q_i = 10.8 N^{0.64}$$

where:

Q_i = Total indoor flow (in gpm) delivered to all connections.

N = Total number of equivalent residential connections

Required storage is 400 gallons per connection.

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 obtained from or approved by the Water Department.

- 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 the final grade of the street, with a maximum of five (5) feet unless otherwise approved by the City Engineer.

Where final grades have not been established, mains shall be installed to a depth great enough to ensure a minimum of three feet and a maximum of five feet of cover below future grade. 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 size of the pipe shall also be based on a five (5) foot per second (fps) velocity maximum at peak instantaneous flows. However, the minimum water main size to be installed shall be eight inches in diameter unless otherwise approved by the City Engineer. Departures from the minimum requirements will be considered only in special circumstances. Any departure from the minimum requirements identified above shall be justified by a network hydraulic analysis. A fire hydrant shall not be connected to a main which does not have sufficient fire flow capacity. In locations where the City has determined line size for the future based on a Master plan Study, the master-planned line size will be installed.

- 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 six hundred 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 be valved at the connection. All fire hydrant runs shall also be valved at the distribution main. 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. Secondary pressure-reducing devices shall be installed by The Owner on all water connections to buildings (IRC).

Pressure reducing valves must be located within the building or on the property which the building being served is located and not within a public right-of-way or city easement. Maintenance shall be the Owner's Responsibility.

3.6.6 FIRE HYDRANT SPACING AND LOCATION. Generally, fire hydrants shall be spaced and located as follows:

- o At each intersection, generally on the same sides of the street.
- o In residential areas, fire hydrant spacing shall be no greater than five hundred feet (500') and no house shall be more than two hundred fifty feet (250') from a hydrant via a street access to the property being served.
- o In multiple-family areas, PUD zones, PD zones, industrial, business, or commercial areas, fire hydrant spacing shall require special investigation to determine the hydrant spacing per the International Fire Code (IFC).
- o Generally, hydrants shall be located in line with extensions of the property line when located mid-block.
- o 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 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 "breakaway" flange at the bottom of hydrants shall be installed so that it is at, or within six (6) inches above, final ground elevation.

- o All fire hydrants shall be owned and maintained by The Water Department and shall be installed on dedicated easements or public rights-of-way.
- o A fire hydrant shall be placed at dead-end lines and at the end of all cul-de-sacs in accordance with the Standard Drawings.
- o A reflective blue raised pavement marker shall be placed in front of the hydrant, approximately 5' from the center line of the road, in the direction of the hydrant.

3.6.7 FIRE FLOW REQUIREMENTS. Under peak day demand conditions, fire flow shall be at least one thousand (1,000) gallons per minute at any one hydrant, and/or must meet the requirements of the Federal Insurance Service Office. The total system design shall be such that fire flows and normal peak instantaneous flow demand (as called out within this sub-section) 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 shall 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 current adopted fire code.

Existing and future static pressure and flow information used in the design shall be approved by the Water Department.

3.6.8 MISCELLANEOUS WATER SYSTEM DESIGN CRITERIA.

3.6.8.1 ALL PUBLIC WATER MAINS: Water mains shall be installed in an easement at least fifteen feet in unobstructed width or in public rights-of-way 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.

- 3.6.8.2 DEAD-END MAINS. Dead-end mains shall be avoided wherever possible and if installed, shall not exceed six hundred 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.
- 3.6.8.3 SEPARATE WATER LINES AND METERS. Unless approved by the City Engineer, each building lot or separate unit shall be served by a separate service line and meter. The minimum size service line from the water main to the meter setter shall be three-quarter inch IPS (3/4" iron pipe size). except in PUDs (or PD's) as approved by The City's Representative.
- 3.6.8.4 SERVICE LINE TAPS. All service line taps shall be machine tapped at the time of the water main installation. Service lines, including meter setters, shall be installed prior to testing and acceptance of the water main. All service lines shall be placed 5' from the property line and opposite the sewer lateral for the lot served. Irrigation lines shall be separated from culinary water lines by a horizontal distance of three feet (3'). Any deviation from this standard will require prior approval from the City Engineer. All laterals shall be installed perpendicular from the main.
- 3.6.8.5 VERTICAL SPACING. When a water main crosses over a sewer main, the water main shall be laid at such an elevation that the bottom of the water main is at least eighteen inches (18") above the top of the sewer. When the water main cannot be as high as eighteen inches (18") above the sewer, the sewer shall be constructed of material with pressure conduit standards for a distance of ten feet (10') on either side of the crossing.
- 3.6.8.7 THRUST RESTRAINTS AND THRUST BLOCKS. 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 (no cement can come into contact with the pipe). The Project Engineer shall design and provide thrust block details. Installation of concrete thrust blocks shall receive prior approval by the City Engineer and inspected prior to the installation of concrete.

- 3.6.8.8 AIR RELEASE VACUUM ASSEMBLIES. Air release vacuum assemblies shall be provided on all mains, where required, to prevent damage due to air accumulations. Minimum pipe depth where air releases are required shall be 4.5 feet of cover. Remote air-vacs will only be allowed upon prior written approval and only under extreme circumstances.
- 3.6.8.9 TRACER WIRE. Tracer wire. All water lines shall require a twelve-gauge solid copper wire with PVC or PC insulation. The wire must 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/barrel.
- 3.6.8.10 SUFFICIENT VALVES. Sufficient valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. Valves shall be generally located as follows:
- o At intervals to isolate no more than two (2) fire hydrants at any time.
 - o At minimum intervals of five hundred (500) feet in commercially zoned areas.
 - o In residential areas, to isolate a maximum of thirty services (approximately six hundred (600) feet).
 - o A maximum of five valves will be required to isolate any location.

- o Valves shall not be located in street gutters, valley gutters, or in driveways.
- o A valve is required at the end of all temporarily dead-ended mains.
- o Valved outlet(s) for future service laterals six (6) inches in diameter and larger may be installed when approved by the City Engineer. (Valved outlet installation approval does not constitute a water commitment.)
- o 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 lateral.
- o The City Engineer may require additional valves as deemed necessary.

3.6.9 NETWORK HYDRAULIC ANALYSIS. Must be performed in accordance with this section. It shall be the responsibility of the design engineer to have flow tests performed on the existing system for use in the analysis. These flow tests must be performed only by qualified personnel and must be witnessed by the City Engineer.

3.6.9.1 DESIGN. The Consulting Engineer shall perform a fire flow test as required to satisfy the requirements of this section.

3.6.9.2 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 City Engineer shall, upon request, make a determination as to which submittal method must be followed. The network hydraulic

analysis submittal shall include two copies of the following items:

- o The data input sheets, as well as the analysis results information about the development (i.e., type, number of acres, number of units, fire flow requirements, etc.)
- o Data sheet(s) outlining all assumptions (i.e., method used to assign demands to corresponding nodes and source HGLs used), map identifying pipe and node numbers and their locations fire hydrant locations
- o The name and version of software used for the analysis elevations of junction nodes, staging or phasing of development, and appropriate off-site demands.

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

- o C equal to 100 for all unlined cast iron pipe
- o C equal to 120 for existing pipe twelve inches or less in diameter
- o C equal to 130 for existing pipe (150 for PVC), fourteen inches or greater in diameter
- o C equal to 130 for new pipe (150 for PVC) regardless of diameter

For any other sizes or materials not covered by the above, the consulting engineer shall contact the City Engineer 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 adverse effects on the existing system.

3.6.10 BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL.

Connections to the culinary water system which jeopardize its quality and integrity shall not be allowed.

- o Cross connections shall not be allowed unless controlled by an approved and properly operating backflow prevention assembly or device (See Standards Drawings). The requirements of the Utah Public Drinking Water Rules (UPDWR) and the Plumbing Code, as adopted by the State of Utah, shall be met with respect to cross connection control and backflow prevention assemblies or devices.
- o The type of protective device or assembly required under this section shall depend upon the degree of hazard which exists at the point of cross connection (whether direct or indirect), applicable to UPDWR and Plumbing Code requirements.
- o Backflow prevention assemblies or devices shall be in-line serviceable (repairable), in-line testable, and have approval through third-party approval agencies to be used within a public drinking water system. Third-party approval shall consist of any combination of two approvals, laboratory or field, performed by a recognized testing organization which has demonstrated competency to perform such tests.

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 Standards.

All valve box covers shall bear the legend "Irrigation" in order to clearly differentiate between culinary and secondary systems.

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. There will 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 Standards. 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.

3.7.1 SECONDARY SYSTEM INSTALLATION: The following will be required for the installation of the secondary system.

- o A one-inch (1") setter (70 series copper setter, VB74-10W-11-44-NL style) and a one-inch (1") meter idler (IDLER-4-NL), or equivalent thereof acceptable to the city, shall be installed to each lot.
- o All piping, including service laterals, must be purple in color and clearly marked "Irrigation".
- o The meter shut off must be installed within a purple meter box clearly marked "Irrigation".
- o All piping to be installed must have a two-foot minimum horizontal and one-foot minimum vertical separation from culinary piping, with the irrigation being installed deeper.

- o All main line valve box lids must be triangular in shape.
 - o The requirements of Sections 3 and 4 will apply for the design and construction of all material.
- 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, TV) will be coordinated and installed by the Developer.
- 3.8.2 STREET LIGHTS. All subdivisions and developments shall include streetlights with wiring and appurtenances installed at the owner's expense in accordance with Rocky Mountain Power's specifications.
- 3.8.2.1. SIDE STREET (Local Street): 25-foot mounting height fiberglass street light pole, direct-buried, for use with cobra head type fixture, smooth gray finish, with 8-foot aluminum cantilever mast arm, 30-foot overall length. Fixture shall be LED, 50W, 4000K, 120-277V, Type 2, PE.
- 3.8.2.2. HIGHWAY (Collector Street): 35-foot mounting height fiberglass street light pole, direct-buried, for use with cobra head type fixture, smooth gray finish, with 8-foot aluminum cantilever mast arm, 40-foot overall length. The fixture shall be LED, 135W, 4000K, 120-277V, Type 3, PE
- 3.8.3 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.
- 3.8.4 LAYOUT. Utility lines shall be located within designated utility easements and in accordance with the requirements of the Joint Utilities Committee (JUC).

- 3.8.5 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.
- 3.8.6 QUALITY CONTROL. All utility trench construction shall conform to the design and testing requirements set forth in SECTION 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 access control requirements for major and minor arterials and major collectors are provided below. In any case where these conflict with adopted zoning ordinance requirements the zoning ordinance shall rule.
- o No driveway access shall be allowed within one hundred fifty feet of the nearest right-of-way line of an intersecting street.
 - o Unless otherwise approved by The City's Representative, access shall be limited to one driveway for each tract of property separately owned. Properties contiguous to each other and owned by the same person are considered to be one tract.
 - o 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.
 - o When approved, or directed by The City's Representative, a driveway access design may be a "street type intersection" with curb returns.
- 3.9.2 TRAFFIC IMPACT STUDIES. The purpose of this sub-section is to establish uniform guidelines for when a Traffic Impact Study (TIS) is required and how the study is to be conducted. A 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.

3.9.2.1 WHEN REQUIRED. A TIS shall be required for all new developments, or additions to existing developments, which generate one hundred or more trips (total in and out vehicular movements) during the morning or afternoon peak hour. The specific analysis requirements and level of detail are determined by the following requirements.

CATEGORY I. Developments which generate one hundred or more peak hour trips, but less than five hundred trips, during the morning or afternoon peak hour.

In addition to the above threshold requirement, Category I TIS may also be required for any of the following reasons:

- o The existence of any current traffic situations or concerns in the local area, such as, but not limited to, an offset intersection or a high number of traffic accidents.
- o The sensitivity of the adjacent neighborhoods or other areas where the public may perceive an adverse impact.
- o The proximity of site driveways to other driveways or intersections.
- o Other specific problems or concerns that may be aggravated by the proposed development.

The study horizon shall be limited to the opening year of the development.

The minimum study area shall include site access drives and adjacent signalized intersections and/or major unsignalized street intersections.

CATEGORY II. Developments which generate from five hundred to one thousand peak hour trips during the morning or afternoon peak hour.

The study horizon shall include both the opening year of the development and five years after opening.

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

CATEGORY II. Developments which generate above one thousand peak hour trips during the morning or afternoon peak hour.

The study horizon shall include the opening year of the development, five years after opening and ten years after opening.

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

3.9.2.2 INITIAL WORK ACTIVITY. The City's Representative makes the final decision on requiring a TIS and determining whether the study falls within Category I, II or III. In addition to the above requirement thresholds, a TIS may be required for:

- o Proposed property rezones
- o When the original TIS is more than two years old, or where the proposed traffic volumes increase by more than ten percent. A Developer, or their agent, shall first estimate the number of vehicular trips to be generated by the proposed development to determine if a TIS may be

required and the applicable category. The City's Representative must give concurrence on the number of trips to be generated by the proposed development. The Developer may, if desired, request that The City's Representative assist in estimating the number of trips for the purpose of determining whether a TIS is required for the proposed development.

- o Next, The City's Representative shall make a ruling whether a TIS is required and what the study category shall be. As previously outlined, The City's Representative may make an independent finding that a TIS is required. If a study is required, The Developer shall have prepared for submittal to The City's Representative, for review and approval, a draft table of contents for the TIS. The table of contents will be sufficiently detailed to explain the proposed area of influence for the study, intersections and roadways to be analyzed, and level of detail for gathering of traffic volume information and preparation of level of service analyses. There shall also be included in the DRAFT a proposed trip distribution for site traffic. After approval of the draft table of contents and trip distribution by The City's Representative, the actual TIS work activities may begin.

The Traffic Impact Study Scope of Work Agreement Between the Engineer and The Developer shall conform to the pre-approved draft table of contents. The findings, conclusions and recommendations contained within the TIS document shall be prepared in accordance with appropriate professional Civil Engineering Canons.

- 3.9.2.3 Qualifications for Preparing TIS Documents. The TIS shall be conducted and prepared under the direction of a Professional Engineer (Civil) licensed to practice in the State of Utah.

The Subject Engineer shall have special training and experience in traffic engineering and be a member of the Institute of Transportation Engineers (ITE).

3.9.2.4 Analysis Approach and Methods: The traffic study approach and methods shall be guided by the following criteria.

- o STUDY AREA. The minimum study area shall be determined by project type and size in accordance with the criteria previously outlined. The extent of the study area may be either enlarged, or decreased, depending on special conditions as determined by The City.
- o STUDY HORIZON YEARS. The study horizon years shall be determined by project type and size, in accordance with the criteria previously outlined.
- o ANALYSIS TIME PERIOD. Both the morning and afternoon weekday peak hours shall be analyzed, unless the proposed project is expected to generate no trips, or a very low number of trips, during either the morning or evening peak periods. If this is the case, the requirement to analyze one or both of these periods may be waived by the City.

Where the peak traffic hour in the study area occurs during a different time period than the normal morning or afternoon peak travel periods (for example, midday), or occurs on a weekend, or if the proposed project has

unusual peaking characteristics, these additional peak hours shall also be analyzed.

- o SEASONAL ADJUSTMENTS. When directed by the City's Representative, the traffic volumes for the analysis hours shall be adjusted for the peak season, in cases where seasonal traffic data is available.

- o DATA COLLECTION REQUIREMENTS. All data shall be collected in accordance with the latest edition of the ITE Manual of Traffic Engineering Studies, or as directed by The City's Representative.
- 1) Turning movement counts: Manual turning movement counts shall be obtained for all existing cross-street intersections to be analyzed during the morning and afternoon peak periods. Turning movement counts may be required during other periods as directed by the City. Available turning movement counts may be extrapolated a maximum of two years with the concurrence of The City's Representative.
- 2) Daily traffic volumes: The current and projected daily traffic volumes shall be presented in the report. If available, daily count data from the local agencies may be extrapolated a maximum of two years with the concurrence of The City's Representative. Where daily count data is not available, mechanical counts will be required at locations agreed upon.
- 3) Accident data: Traffic accident data shall be obtained for the most current three-year period available.
- 4) Roadway and intersection geometrics: Roadway geometric information shall be obtained. This includes, but is not limited to, roadway width, number of lanes, turning lanes, vertical grade, location of nearby driveways, and lane configuration at intersections.
- 5) Traffic control devices: The location and type of traffic controls shall be identified.
- o TRIP GENERATION. The latest edition of ITE's Trip Generation shall be used for selecting trip generation

rates. Other rates may be used with the approval of The City's Representative in cases where Trip Generation does not include trip rates for a specific land use category, or includes only limited data, or where local trip rates have been shown to differ from the ITE rates.

Site traffic shall be generated for daily, AM, and PM peak hour periods. Adjustments made for "passer-by" and "mixed-use" traffic volumes shall follow the methodology outlined in the latest edition of the ITE Trip Generation Manual. A "passer-by" traffic volume discount for commercial centers shall not exceed twenty-five percent unless approved by the City's Representative.

A trip generation table shall be prepared showing proposed land use, trip rates, and vehicle trips for daily and peak hour periods and appropriate traffic volume adjustments, if applicable.

- o TRIP DISTRIBUTION AND ASSIGNMENT. Projected trips shall be distributed and added to the projected non-site traffic on the roadways and intersection under study.

The specific assumptions and data sources used in deriving trip distribution and assignment shall be documented in the report. Future traffic volumes shall be estimated using information from transportation models or applying an annual growth rate to the baseline traffic volumes. The future traffic volumes shall be representative of the horizon year for project development.

In addition, any nearby proposed "on-line" development projects shall be taken into consideration when forecasting future traffic volumes. The increase in traffic from proposed "on-line" projects shall be compared to the increase in traffic by applying an annual growth rate.

If modeling information is unavailable, the greatest traffic increase from either the "on-line" developments, the application of an annual growth rate, or a combination of an annual growth rate and "on-line" developments, shall be used to forecast the future traffic volumes.

The site-generated traffic shall be assigned to the street network in the study area based on the approved trip distribution percentages. The site traffic shall be combined with the forecasted traffic volumes to show the total traffic conditions estimated at development completion. A "figure" will be required showing daily and peak period turning movement volumes for each traffic study intersection. In addition, a "figure" shall be prepared showing the base-line volumes with site-generated traffic added to the street network.

This "figure" shall be prepared showing the base-line volumes with site-generated traffic added to the street network. This "figure" will represent site specific traffic impacts to existing conditions.

- o CAPACITY ANALYSIS. Level of Service (LOS) shall be computed for signalized and unsignalized intersections in accordance with the latest edition of the Highway Capacity Manual. The intersection LOS shall be calculated for each of the following conditions (if applicable):
 - 1) Existing peak hour traffic volumes ("figure" required).
 - 2) Existing peak hour traffic volumes, including site-generated traffic ("figure" required).
 - 3) Future traffic volumes not including site traffic ("figure" required).

- 4) Future traffic volumes, including site traffic ("figure" required).
- 5) LOS results for each traffic volume scenario ("table" required).

The LOS table shall include LOS results for AM and PM peak periods if applicable. The table shall show LOS conditions with corresponding vehicle delays for signalized intersections, and LOS conditions for the critical movements at unsignalized intersections. For signalized intersections, the LOS conditions and average vehicle delay shall be provided for each approach and the intersection as a whole.

Unless otherwise directed by The City's Representative, the capacity analysis for existing signalized intersections shall be conducted using the Highway Capacity Manual Planning Method for each study horizon year. When directed by the City's Representative, the capacity analysis shall be conducted using the Operational Analysis Method.

If an operational capacity analysis method is used for existing signalized intersections, it shall include existing phasing, timing, splits, and cycle lengths as observed and measured during the peak hour traffic periods.

For unsignalized intersections, the Highway Capacity Manual methodology shall be used.

If the new development is scheduled to be completed in phases, the TIS will, if directed by The City's Representative, include an LOS analysis for each separate development phase in addition to the TIS for each horizon year. The incremental increases in site traffic from each phase shall be included in the LOS analysis for each preceding year of development completion. A "figure" will be required for each horizon year of phased development.

- o **TRAFFIC SIGNAL NEEDS.** A traffic signal needs study shall be conducted for all new proposed signals for the base year. If the warrants are not met for the base year, they should be evaluated for each year in the five-year horizon.
- o **ACCIDENT ANALYSIS.** An analysis of three-year accident data shall be conducted to determine if the level of safety will deteriorate due to the addition of site traffic.
- o **SPEED CONSIDERATIONS.** Vehicle speed is used to estimate safe stopping and cross-corner sight distances. In general, the posted speed limit is representative of the 85th percentile speed and may be used to calculate safe stopping and cross corner sight distances.
- o **IMPROVEMENT ANALYSIS.** The roadways and intersections within the study area shall be analyzed, with and without the proposed development to identify any projected impacts in regard to level of service and safety.
- o **CERTIFICATION.** The TIS shall be prepared under the supervision of a Professional Engineer (Civil) registered in the State of Utah. The report shall be sealed and signed.

3.9.3 STUDY AND REPORT FORMAT. This sub-section provides the format requirements for the general text arrangement of a TIS. Deviations from this format must receive prior approval of The City.

- 1. INTRODUCTION AND SUMMARY:** Purpose of Report and Study Objectives Executive Summary
 - Site Location and Study Area
 - Development Description
 - Principal Findings
 - Conclusions
 - Recommendations

2. PROPOSED DEVELOPMENT

- Site Location (vicinity map)
- Land Use and Intensity
- Development Details Proposed
- Site Plan (readable version must be provided)
- Access Geometrics
- Development Phasing and Timing

3. STUDY AREA CONDITIONS

- Study Area
 - ❖ Area of Significant Traffic Impact
 - ❖ Influence Area
- Land Use
 - ❖ Existing Land Use
 - ❖ Anticipated Future Development
- Site Accessibility
 - ❖ Existing and Future Area Roadway System

4 ANALYSIS OF EXISTING CONDITIONS

- Physical Characteristics
 - ❖ Roadway Characteristics
 - ❖ Traffic Control Devices
 - ❖ Pedestrian/Bicycle Facilities
- Traffic Volumes
 - ❖ Daily, Morning, and Afternoon Peak Periods (two hours minimum, and others as required)
- Level of Service
 - ❖ Morning Peak Hour, Afternoon Peak Hour (and others as required)
- Safety
- Data Sources

5 PROJECTED TRAFFIC

- Site Traffic Forecasts (each horizon year)
 - ❖ Trip Generation
 - ❖ Mode Split
 - ❖ Pass-by Traffic (if applicable)
 - ❖ Trip Distribution
 - ❖ Trip Assignment
- Non-Site Traffic Forecasting (each horizon year)
 - ❖ Projections of Non-site Traffic (Methodology for the projections shall receive prior approval of Owner's Representative)
- Total Traffic (each horizon year)

6. TRAFFIC AND IMPROVEMENT ANALYSIS

- Site Access
- Level of Service Analysis
 - ❖ Without Project (for each horizon year, including any programmed improvements)
 - ❖ With Project (for each horizon year, including any programmed improvements)
- Roadway Improvements
 - ❖ Improvements Programmed to Accommodate Non-site Traffic
 - ❖ Additional Alternative Improvements to Accommodate Site Traffic
- Traffic Safety
 - ❖ Sight Distance
 - ❖ Acceleration/Deceleration Lanes, Left-Turn Lanes
 - ❖ Adequacy of Location and Design of Access

- Pedestrian Considerations
- Speed Considerations
- Traffic Control Needs
- Traffic Signal Needs (base plus each year in five-year horizon)

7. CONCLUSIONS

8. RECOMMENDATIONS

- Site Access
- Roadway Improvements
- Phasing

9. APPENDICES

- Traffic Volume Counts
- Capacity Analysis Worksheets
- Traffic Signal Needs Studies
- Accident Data and Summaries

10. FIGURES AND TABLES (The following items shall be documented in the text or Appendices)

- Site Location
- Site Plan
- Existing Transportation System
- Existing Peak Hour Turning Volumes
- Collision Diagram(s)
- Estimated Site Traffic Generation
- Directional Distribution of Site Traffic
- Site Traffic
- Non-Site Traffic
- Total Future Traffic
- Projected Levels of Service
- Recommended Improvements

(For Category I, many of the items may be documented within the text. For other categories, the items shall be included in figures and/or tables which are legible.)

11. DESIGN STANDARD REFERENCE

Design in accordance with current Owner's Design and Construction standards.

Conduct capacity analysis in accordance with the latest edition of the Highway Capacity Manual.

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

3.10.1 GENERAL REQUIREMENTS. Only A Land Surveyor licensed 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:

- o All angle points in survey boundary (Class II).
- o All angle points of tangency and points of curvature on and along survey boundary (Class II).
- o All street centerline intersections Class I).
- o At a P.I. outside of right-of-way (Class II). If the P.I. falls outside the limits of pavement, then P.C.'s and P.T.'s shall be monument with Class I.

If the P.I. falls inside the pavement area, then a Class I monument is required, and no monuments are required for P.C.'s and P.T.'s.

- o All intersections of street centerlines at survey boundary (Class II).
- o Six hundred-foot intervals, 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 City Surveyor.

All the above established points which fall within the limits of public or private rights-of-way way shall be referenced with four permanently established reference points within a radius of twenty (20) feet to one hundred (100) feet, all of which shall be outside the pavement area. The angle from tie to tie shall be as near ninety degrees as possible, radiating from the established intersection points. A copy of the survey notes documenting the setting of the reference ties shall be kept by the responsible surveyor, and a copy shall be delivered to the office of The City Surveyor and of The County Surveyor's Depository.

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 and the City 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 The City requirements.

3.11 DEFINITIONS.

ASHTO – American Association of State Highway and Transportation Officials

ADA – Americans with Disabilities Act

ADT – Average Daily Traffic

DU'S – Dwelling Units

FEMA – Federal Emergency Management Act

FESWMS – Federal Emergency Storm Water Management Service

FHWA – Federal Highway Administration

HEC – Hydraulic Engineer Circular

ITE – Institute of Transportation Engineers

PC – Point of Curve

PI – Point of Intersection

PT – Point of Tangent

PUD – Planned Unit Development

TIS – Traffic Impact Study

UDOT – Utah Department of Transportation

SECTION 4
CONSTRUCTION STANDARDS



4.1 INTRODUCTION	138
4.2 SURVEY REQUIREMENTS	138
4.3 EARTHWORK	138
4.3.1 DEFINITIONS	138
4.3.2 MATERIALS	139
4.3.2.1 EXCAVATION	139
4.3.2.2 SUBSOIL REINFORCEMENT	139
4.3.2.3 BACKFILL	139
4.3.2 CONSTRUCTION METHODS	140
4.3.2.1 CONSTRUCTION OF EMBANKMENTS	140
4.3.2.2 COMPACTION OF EARTH MATERIALS	141
4.3.2.3 SUB GRADE PREPARATION	142
4.3.2.4 CONSTRUCTION OF NON – STRUCTURAL FILLS	143
4.3.3 QUALITY CONTROL	143
4.3.3.1 TESTING	143
4.3.3.2 ACCEPTANCE	144
4.3.4 SPECIAL REQUIREMENTS	144
4.4 PIPELINE CONSTRUCTION	145
4.4.1 MATERIALS	145
4.4.1.1 SEWER PIPE AND FITTINGS	145
4.4.1.2 STORM DRAIN PIPE	145
4.4.1.3 MANHOLES	148
4.4.1.4 CULINARY AND SECONDARY WATER PIPE AND FITTINGS	151
4.4.2 CONSTRUCTION METHODS	163
4.4.2.1 STANDARDS	163
4.4.2.2 CONTROL OF GROUND WATER	164
4.4.2.3 EXCAVATION FOR PIPELINES	165
4.4.2.4 SHEETING, BRACING, SHORING OF EXCAVATIONS	167
4.4.2.5 PIPE LAYING AND BEDDING	168
4.4.2.6 BACKFILLING AND COMPACTION	173
4.4.2.7 REQUIREMENTS FOR CUTTING INTO NEW ROADS	177
4.4.2.8 TRENCHES ON HIGHWAYS AND STREETS	181
4.4.2.9 CLEANING AND DISINFECTION OF WATER SYSTEMS	183
4.4.2.10 SPECIAL REQUIREMENTS	184
4.4.3 QUALITY CONTROL	185
4.4.3.1 TRENCH BACKFILL MOISTURE/DENSITY TESTING	186

4.4.3.2 STORM DRAIN TESTING AND ACCEPTANCE	186
4.4.3.3 WATER SYSTEM TESTING AND ACCEPTANCE	191
4.4.3.4 SEWER SYSTEM TESTING & ACCEPTANCE	193
4.5 ROADWAY CONSTRUCTION	193
4.5.1 GENERAL REQUIREMENTS	193
4.5.2 CONSTRUCTION STAKING	194
4.5.3 GRADE CONTROL SYSTEMS	195
4.5.4 GEOTECHNICAL INVESTIGATION	196
4.5.5 ROADWAY SUB-GRADE	198
4.5.5.1 PREPARATION	198
4.5.5.2 TOLERANCES	199
4.5.6 SUBBASE - CLASS I AND CLASS II	199
4.5.6.1 SUBBASE ACCEPTANCE TESTING REQUIREMENTS AND TOLERANCES	201
4.5.7 UNTREATED ROADBASE – ONE INCH AND THREE-QUATER INCH	202
4.5.7.1 UNTREATED BASE ACCEPTANCE TESTING REQ.	205
4.5.8 PRIME COAT	206
4.5.9 TACK COAT	208
4.5.10 DENSE-GRADED ASPHALT	209
4.5.10.1 MIX DESIGN	209
4.5.10.2 RECYCLED ASPHALT PAVEMENT (RAP)	210
4.5.10.3 RELATED WORK	210
4.5.10.4 ASPHALT CEMENT	210
4.5.10.5 SHIPMENT OF ASPHALT MATERIAL	213
4.5.10.6 HYDRATED LIME FOR ASPHALT MIXTURE	214
4.5.10.7 MIX PROPERTIES	215
4.5.10.8 AGGREGATE	216
4.5.10.9 ACCEPTANCE TESTING REQUIREMENTS AND TOLERANCES	218
4.5.10.10 UNACCEPTABLE ASPHALTIC PAVEMENT MATERIALS	220
4.5.10.11 STORING, MIXING AND SHIPPING OF PLANT MIX PAVEMENTS	221
4.5.10.11.1 STORAGE	221
4.5.10.11.2 BATCH PLANT METHOD	222
4.5.10.11.3 DRIER-DRUM METHOD	224
4.5.10.11.4 ASPHALT CONCRETE SURGE AND STORAGE SILOS	228
4.5.10.11.5 SHIPPING ASPHALT MIXTURES	230
4.5.10.12 SURFACE PREPARATION FOR ASPHALT OVERLAY	230
4.5.10.13 ADJUSTMENT OF MANHOLE AND UTILITY COVERS	231

4.5.10.14 ASPHALT PAVING EQUIPMENT	231
4.5.10.15 ROLLERS	233
4.5.10.16 WEATHER AND DATE LIMITATIONS	234
4.5.10.17 SPREADING AND FINISHING	234
4.5.10.18 ROLLING AND COMPACTING	237
4.5.10.19 SURFACE TREATMENT	241
4.6 BITUMINOUS SEAL COAT (CHIP SEAL)	241
4.6.1 MATERIAL SPECIFICATIONS	241
4.6.1.1 BITUMINOUS MATERIAL	241
4.6.1.2 AGGREGATE (CHIPS)	242
4.6.2 AGGREGATE QUALITY CONTROL	243
4.6.3 EQUIPMENT	244
4.6.3.1 ASPHALT DISTRIBUTOR	245
4.6.3.2 AGGREGATE SPREADER	245
4.6.3.3 ROLLERS	246
4.6.3.4 DUMP TRUCKS	246
4.6.3.5 FRONT END LOADERS	246
4.6.3.6 POWER BROOMS	246
4.6.4 BITUMINOUS CHIP SEAL CONSTRUCTION METHODS	246
4.6.4.1 SURFACE PREPARATION	246
4.6.4.2 ASPHALT APPLICATION	247
4.6.4.3 AGGREGATE SPREADING	248
4.6.4.4 AGGREGATE COMPACTION	249
4.6.4.5 LOOSE AGGREGATE REMOVAL	250
4.6.4.6 SANDING	250
4.6.4.7 APPEARANCE	251
4.6.4.8 WEATHER LIMITATIONS	251
4.7 ASPHALT EMULSION SEAL COAT (SLURRY SEAL)	251
4.7.1 EQUIPMENT	251
4.7.1.1 SLURRY SEAL MIXING MACHINE	252
4.7.1.2 SLURRY SPREADER	252
4.7.1.3 SURFACE CLEANING EQUIPMENT	253
4.7.1.4 AUXILIARY EQUIPMENT	253
4.7.2 ASPHALT EMULSION SLURRY CONSTRUCTION METHODS	253
4.7.2.1 RESIDENT NOTIFICATION	253
4.7.2.2 VEHICLE REMOVAL	253

4.7.2.3 PREPARATION OF SURFACE	253
4.7.2.4 CLEANING STREETS	254
4.7.2.5 SEWER MANHOLE LIDS AND WATER VALVE COVERS	254
4.7.2.6 TEST SECTION	255
4.7.2.7 WATER FOG	255
4.7.2.8 PREPARATION OF SLURRY	255
4.7.2.9 APPLICATION OF SLURRY	256
4.7.2.10 HANDWORK	256
4.7.2.11 JOINTS	256
4.7.2.12 CURING	257
4.7.2.13 WEATHER LIMITATIONS	257
4.8 CONCRETE WORK	257
4.8.1 MATERIALS	257
4.8.1.1 PORTLAND CEMENT CONCRETE MATERIAL	257
4.8.1.2 CONCRETE REINFORCING MATERIALS	266
4.8.1.3 CURB, GUTTER, SIDEWALK AND BASE MATERIALS	268
4.8.2 CONSTRUCTION METHODS AND EQUIPMENT	269
4.8.2.1 GENERAL CONCRETE PLACEMENT	269
4.8.2.2 CONCRETE REINFORCEMENT INSTALLATION	272
4.8.2.3 CURB, GUTTER AND SIDEWALK CONCRETE PLACEMENT	274
4.8.2.4 CONCRETE BASE MATERIALS PLACEMENT	279
4.8.3 QUALITY CONTROL	279
4.8.3.1 CONCRETE TESTING	279
4.8.3.2 CONCRETE BASE MATERIAL TESTING	280
4.8.3.3 ACCEPTANCE	281
4.9 RESTORATION OF EXISTING SURFACE IMPROVEMENTS	282
4.9.1 INTRODUCTION	282
4.9.2 GRAVEL SURFACES	283
4.9.3 BITUMINOUS SURFACES	283
4.9.4 CONCRETE SURFACES	284

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 City Engineer. The staking shall have all necessary information, including, but not limited to, stationing, cut or fill data, offset 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 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 DEFINITIONS.

EMBANKMENT: shall refer to any raised area of compacted earth to support a roadway, structure, parking lot, etc. The material used for embankment shall be specified, and tests shall be performed to determine the fill material's adequacy for the specific project.

FILL: shall refer to any material used to fill a depression. It is any material which can be compacted enough to prevent settlement, such as earth, broken-up concrete, old building blocks, crushed stone or material from a riverbank, etc. (Embankment is a type of fill.)

BACKFILL: shall refer to any earth that has been excavated from a trench or other excavation and then replaced and compacted as specified after the structure has been installed.

MAXIMUM DRY DENSITY: as determined by laboratory testing in accordance with ASTM D-1557 (Modified Proctor) or ASTM D-698 (Standard Proctor), or equivalent AASHTO T-180 or T-99 methods, selected as appropriate for fine-grained or coarse-grained soils.

4.3.2 MATERIALS. Earthwork materials shall conform to the following:

4.3.2.1 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 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 percent (95%) of maximum dry density.

4.3.2.2 SUBSOIL REINFORCEMENT. Coarse gravel, crushed stone, or a geotextile may be used for subsoil reinforcement when approved by The City Engineer. Coarse gravel or crushed stone shall be applied in six (6) inch layers and tested. 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.

4.3.2.3 BACKFILL. Backfill shall be placed to the lines and grades shown on the approved drawings, or as directed by The City'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 inches (6") in compacted thickness. Each layer shall be compacted to a minimum density of ninety-five percent (95%) of maximum dry density for granular soils or ninety percent (90%) of maximum dry density for silt/clay (fine-grained) soils.

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 City Engineer, 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 well-graded and free from deleterious materials and rocks larger than four inches (4") in diameter, and all other material unsuitable for construction of embankments. Rocks larger than four inches (4") may be used when recommended by The Geotechnical Engineer and approved by The City Engineer.

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 inches (8") 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 percent (2%-5%) above 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 one foot 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 percent (95%) for granular soils and ninety percent (90%) for fine-grained soils. Other fills and embankments not noted above shall be compacted to ninety percent (90%) maximum dry density.

When compaction cannot be met with native or imported materials, a sand slurry mix (no gravel) may be used in lieu

of compacted materials for backfill, which is above the six to eight (6-8) inch zones above the pipe.

Exposed natural soils within construction areas, beneath walkways, slabs, and pavement shall be scarified to a depth of twelve inches (12"), 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 follow the IRC/IBC and shall be uniform throughout and shall not be placed partially on undisturbed soil or compacted fill and partially on cemented deposits or rock.

- 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 six inches (6") 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 over-excavation and re-compaction 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 City's Representative shall be notified immediately. Work shall not proceed until an acceptable mitigation plan is approved. Groundwater 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 over-excavated, and the material removed from the site. Select borrow material may be imported,

placed, and compacted as directed by the City'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 should be proof-rolled with pneumatic tires or other acceptable equipment of at least ten-ton capacity. All proof-rolling shall be accomplished in the presence of The City's Representative. When proof-rolling indicates that an area is unstable, the Contractor shall contact the Geotechnical Engineer for stability recommendations. The subgrade 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:

- o 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.

- o Soil Proctor - One determination for each significant change in soil type as necessary to provide required compaction testing. Tests shall be performed using method ASTM D-1557 (Modified Proctor) or ASTM D-698 (Standard Proctor), or the equivalent AASHTO T-180 or T-99 methods, as appropriate for fine-grained or coarse-grained soils.
- o Earth Fill Moisture/Density Determination - One test per five hundred (500) cubic yards of fill placed in an embankment. Tests shall be determination - ASTM D-1556 or D-2922 and D-3017.
- o Subgrade moisture/density determination - One test per one thousand square yards of surface area. Moisture density determinations shall be made in accordance with requirements of The City.

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 IRC/IBC Building Codes.

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 section specifies acceptable pipe and accessories for underground culverts, storm drains, and water pipe construction. The materials used for pipe and fittings shall all be new and conform to the requirements for class, brand, size and material as specified. Each pipe used shall have a manufacturer's stamp on it indicating that it complies with the requirements of the appropriate specification. Any pipe not so stamped shall be rejected. All pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects.

All pipe joints shall be bell and spigot type with rubber ring gaskets to permit expansion and contraction.

Pipe and fittings shall be assembled with a nontoxic lubricant.

4.4.1.1 SEWER PIPE AND FITTINGS. Please refer to Ash Creek Special Service District's Standards & Specifications.

4.4.1.2 STORM DRAIN PIPE. All pipes listed under these standards, as well as the following pipes, may be used in the construction of storm drain lines and culverts. Pipes containing recycled material meeting the ASTM F2648 standard are acceptable, provided they meet all other requirements for Class C, Smooth pipe. Along with the UDOT Class C, Smooth, pipelines shall also meet the following requirements:

- o NON-REINFORCED CONCRETE PIPE. If approved by the City Engineer, non-reinforced concrete sewer pipe may be used for storm drains, up to and including eighteen-

inch size. 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 City's Representative. Joints shall be of the bell and spigot with rubber gasket design, and with joints and gaskets conforming to the requirements of ASTM Designation C 443. Pipe joints shall be so designed as to provide for self-centering, and when assembled, to compress the gasket 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.

- o REINFORCED CONCRETE PIPE. Unless otherwise approved by the City Engineer, reinforced concrete pipe shall be used for all storm drains greater than eighteen inches in diameter, and for all drains of smaller size where installation does not provide a cover of at least three feet over the top of the pipe. Reinforced concrete pipe shall comply with the requirements of ASTM C 76 (Class II) unless otherwise approved by the City's Representative. Joints shall be of the bell and spigot design with rubber gasket type joints for storm drains, with an alternate option of tongue and groove mortar joints for storm drain lines when approved by The City's Engineer.
- o CORRUGATED POLYETHYLENE PIPE. Corrugated polyethylene pipe shall be high-density polyethylene corrugated exterior/smooth interior pipe, twelve to thirty-six-inch diameters shall conform to AASHTO M 294 Type S; eight to ten-inch diameter shall meet the strength requirements of AASHTO M252, with the addition that the pipe have a smooth interior liner. Materials shall conform to ASTM D 3350. All pipe joints and fittings shall be watertight and conform to AASHTO M353 or M294 and shall be approved by the City's Representative.

- o 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, 1992.
- o CORRUGATED STEEL PIPE. Use of corrugated steel pipe shall require pre-approval from the City Engineer 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 watertight joints per ASTM F2487. O-ring gaskets or other acceptable materials shall be used.

o Misc.

- 1) 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.
- 2) INSTALLATION. Installation shall be in accordance with the manufacturers' 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 MANHOLES. This subsection covers the requirements for the materials used in storm and water manholes. Manholes shall be watertight 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 IL (10) HS cement shall be used for precast and cast in place bases.

Where storm water 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 stormwater 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 or 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 ring 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.

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 City's 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 watertight. Any cracks or imperfections shall be satisfactorily repaired. Materials and methods used shall be subject to approval of The City'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 "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 City's Representative. When set in roadways, walkways or other travel ways, 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 City'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-eighths (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 CULINARY AND SECONDARY WATER PIPE AND FITTINGS. The materials used for culinary and secondary water 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 City's Representative. All pipe materials are as outlined below.

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

SIZE	TYPE
¾" – 2"	MUNICIPEX CTS (blue for culinary, purple for secondary)
2 ½ - 3"	PVC (no glued fittings)
4" & Larger	Ductile Iron Thickness Class 51 with poly jacket sock or, PVC C900 (sand bedded)

All culinary pipe shall be blue in color. All secondary or irrigation pipe 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 Water Department shall be allowed to connect or disconnect water meters.

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

C.1 JOINTS. Ductile Iron Pipe shall be 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 6-mil minimum thickness polyethylene wrap shall be required on all ductile iron pipes. 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.

C.3 POLYETHYLENE WRAPPING. A polyethylene wrapping shall be required on all metal or iron fittings, hydrants, valves, and joint restraints.

D. PVC PIPE. All PVC Pipe used shall meet the latest AWWA standard C-900. PVC pipe shall be rated to the maximum anticipated pressure with a minimum pressure rating of 235 psi. All PVC pipe shall be made from clean, virgin, type 1, grade 1, polyvinyl chloride conforming to ASTM resin specification D1784.

D.1 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 shall be cement-lined and seal-coated in accordance with ANSI/AWWA C-104/A21.04.

E. COPPER PIPE. Where service lines are two inch or less in diameter, Type K copper pipe may be allowed with prior approval of the City's Representative. Pipe which has outside dimensions greater than two inches in diameter shall not be copper. All copper pipe shall conform to the current AWWA standards.

F. TAPPING. All wet tapping larger than 2" inch in diameter will require prior approval from the City and will require a ductile tapping sleeve.

G. TAPPING MATERIAL SPECIFICATION. For small tapings (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:

G.1 SADDLE CASTINGS. Large saddle tapings shall be stainless steel / bronze single/double strap /cast saddle or approved by a City Representative.

G.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 taping saddles shall have polyethylene wrapping.

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

H. VALVES AND BOXES. Unless otherwise specified by The Water Department, all valves, twelve (12) inches and smaller, shall be of a resilient-seat-gate-valve type. All valves over twelve (12) inches shall be butterfly valves capable of withstanding hydrostatic pressure test to 200.

H.1 GATE AND BUTTERFLY VALVES. Valves shall conform to the latest version of AWWA valve standards. All Valves shall be new and Kennedy. Exceptions to this requirement will require approval from the City's Representative.

All valves, twelve inch and less, installed next to a fitting must be flange x MJ and installed with the flange end connecting to the tee, cross, or fitting and megaluged to the line unless otherwise approved by the City's Representative. Valves greater than twelve inches shall have flange x flange with an MJ adaptor in order to flange to tee, cross, or fitting and megalug to line.

All six- and eight-inch valves shall have a 16"x16"x4" slab of concrete placed under them for support. Valves ten inch and greater shall have a 20"x20"x4" slab placed under them for support. All support slabs shall be fastened to the valves.

H.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 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 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 feet each way along the trench with a concrete collar in accordance with the standard drawings.

I. WATER SERVICE LATERALS. The material used for water service connections shall comply with the following requirements.

I.1 SERVICE PIPE. Service pipe shall be in accordance with Section 4.4.1.4.A. 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. “Crimping” of service line is not allowed. A system shutdown will need to be scheduled for repairs.

I.2 CORPORATION STOPS. Corporation stops shall be as manufactured by the Mueller Company, or Ford or approved equal and shall be male x male conforming to the designations shown below for the various sizes.

MANUFACTURER	WATER CONNECTION SIZE			
	3/4"	1"	1-1/4" to 1-1/2"	2"
MUELLER	H- 10013 N	H- 10013 N	H- 10013 N	H- 10013 N
FORD	F400	F400	FB400	FB400

I.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. All setter yokes shall be installed center of barrel and at a depth of 8" minimum and 10" maximum below top of the barrel. Meters shall be installed by the Water Department personnel only. All setter shut-off valves shall be provided with bronze handles.

I.3.1 IRRIGATION YOKES. Irrigation yokes shall be a 1" (70 series copper setter) (VB74-10W-11-44-NL style) with a 1" meter idler (IDLER-4-NL) and shall be installed to each lot.

I.. 4 METER BARREL/BOX AND LID. Meter barrels shall be used for culinary water. Meter boxes shall be used for irrigation. The meter barrels shall be black or white, high density polyethylene ADS N-12 or equal, eighteen inches diameter by twenty-four-inch depth (standard size) or as otherwise approved by The Water Department. The meter lids shall be 18" cast iron ring and lid. Lid marking shall be approved by The Water Department.

All meter barrels/boxes shall be placed behind sidewalks in the ten-foot easement along the frontage and within two feet of the sidewalk in accordance with the standard drawings, unless otherwise directed by the City's Representative

Irrigation meter boxes shall be purple in color.

Any meter barrel/box located within areas subject to vehicles shall be constructed of concrete or other approved composite material and capable of withstanding HS20 loading. These boxes/barrels shall be oversized to the next size above or as directed by the Water Department and include a cut-out area for repair.

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

1.5 SERVICE CONNECTIONS. At all points designated by The Water Department, service connections shall be installed and shall extend from the property line to the building, unless otherwise directed by The Water Department.

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 Department, the water service shall be one and one-half (1 1/2) or two inches in diameter. Services shall have a minimum of three (3) feet of cover 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 inches (12) from the end of the main, or 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 approved mechanical joint sleeves and type shall be as shown in the standard drawings.

All hot taps 2” and smaller shall be performed by The City’s Water Department. Hot taps over 2” shall be done by a 3rd party and cost paid by the Developer.

I 5.1 CURB MARKING. At the point where the service line crosses under the curb, a “W” for water, or a “I” for Irrigation “S” for sewer, will be neatly stamped or inscribed into the face of the curb.

J. MARKING WIRE. Marking wire shall be installed on all waterline installations unless otherwise approved by the the City’s Representative. Marking wire shall conform to the following and must be 12-gauge solid copper with PVC or PE insulation:

- o 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.
- o Marking wire should be taped and pulled tight along the top of the pipe to ensure against breakage.
- o Marking wire shall extend up to all hydrants, valves, and meter boxes/barrels following service lines into meter box/barrel. At valve clusters, marking wire shall be run to all valves. The wire should be installed to the corresponding valve of the water line to be located.

- o Marking wire shall extend out of the valve box a minimum of twelve (12) inches.
- o 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.
- o After all the boxes are raised, the Contractor shall notify the Water Department to perform the final acceptance testing.

K. FIRE HYDRANTS. Fire hydrants shall be Kennedy, Model K81D, or approved equal with a four-and-one-half-inch pumper nozzle, (2) two-and-one-half-inch hose nozzles, a five-and-one-fourth-inch main valve and six-inch mechanical joint connection. Fire hydrants shall conform to the latest edition of AWWA C-502, "Dry Barrel Fire Hydrants," and shall be UL-listed and FM-approved. All hydrants shall be designed for a working pressure of two hundred psi and a hydrostatic pressure of three hundred fifty psi. It shall be the responsibility of the Owner to furnish hydrants with a finish paint above the ground line identical 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 Water Department.

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

Dead-end mains shall not be installed without prior approval of the Water Department. 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 Water Department.

Hydrants shall be of a flanged joint type or mechanical joint inlet with cast iron break coupling. The break coupling pins shall be stainless steel with a spring-loaded push pin to act as the retainer of the coupling pin. 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. The break flanges shall be mounted on top of the ground line flange to assist with the ease of maintenance. The lower portion of the ground line flange is to have slots where the bolts are located to help with a clean break upon impact.

All hydrant nozzles shall be furnished with a cap and gasket with attaching chain. Nozzles shall be of the tamper-resistant, 1/4 turn type with O-ring seals and stainless steel retaining screws. All hydrants shall open counterclockwise with a pentagon operating nut conforming in size to the specifications of The Water Department. Operating nut shall be of one-piece bronze construction. A dirt shield shall be provided to protect the operating mechanism from grit buildup and corrosion due to moisture. A thrust washer shall be supplied between the operating nut and stem lock nut to facilitate operation.

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 blocked against the end of the trench with concrete. 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 (1½) inch gravel shall be placed around the drain holes just above the hydrant valve casing. Hydrant drain valve shall momentarily force flush with each operation. Drainway shall be of bronze. Drain valve facing shall be of synthetic rubber with a stainless-steel retaining pin.

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 street utility easements or as otherwise directed by The Water Department.

- L. PRESSURE REDUCING VALVES. Pressure reducing valve installation will be constructed as per the detail shown in the standard drawings. The valves will be as manufactured by Singer or CLA-Val approved by The City Engineer.
- M. MEGA LUG SYSTEM. A mega lug 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 80 head bolts and shall be used to ensure proper activation of restraining

devices. The gland shall be manufactured of ductile iron conforming to ASTM A-536-80. 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 Mega lug by EBAA Iron, Inc. or approved equal. The type and model of retainer and amount for each connector is shown on standard drawings.

A mega lug retainer gland system shall be used on all mechanical joints and shall meet Uni-B-13 for PVC and be UL/FM approved.

As an alternate to the mega lug 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. These materials listed are approved for use on The City's Water System. All other shall require prior approval.

Thrust blocks shall only be placed to accommodate connection to existing facilities and only where deemed necessary by The Engineer and agreed to by The City.

4.4.2 CONSTRUCTION METHODS. This subsection covers the requirements for trenching, placing, and backfilling of all underground pipelines (water, irrigation, 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 STANDARDS.

- o Safety: uring the entire trenching, backfilling, and patching operations, the Contractor will be required to observe all safety and traffic control procedures.

- o Maintenance: The Contractor shall be responsible for maintenance of the trench and patch for a period of twelve (12) months from the date of the completion of the patching operation.
- o Limitations: Unless otherwise approved by the City representative, not more than four hundred feet (400') of trench shall be left unfilled at any time in one continuous run. Up to 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 planned for completion in one working day so that no trenches are left open overnight.
- o Dust: All streets and roads trenched shall be kept free from dust and open to through traffic unless permission to close the street is obtained by the contractor from The City Representative.
- o Right of Way: All requirements governing work within a right of way shall be addressed in general traffic regulations and road closures as outlined.

4.4.2.2 CONTROL OF GROUND WATER. All trenches shall be kept free from water during excavation, fine grading, and 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 that 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.

- 4.4.2.3 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 of three (3) feet over the pipe unless otherwise approved by The City's Representative. Pipe installation shall be in accordance with the pipe manufacturer's recommendations. The bottom two 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 six 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-inch lifts to provide a smooth, well-compacted, and stable foundation for the pipe

or appurtenant works. Bedding material shall consist of imported screened sand.

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 as, 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 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 inches. Each layer shall be compacted by tamping, rolling, vibrating, spading, slicing, rotting, 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 City'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 wastewater 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 four hundred (400) feet, unless otherwise approved by The City's Representative. Open trenches shall not be allowed to stay open without proper safety

precautions and barricading. Trenches should not be left open overnight.

In the event "foundation material" is used in backfill, or replacement of over excavated material, the Contractor shall, 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 4.1 BACKFILL MATERIAL				
SLEEVE SIZE	FOUNDATION MATERIAL	BEDDING/ PIPE ZONE MATERIAL	1 FT ABOVE PIPE ZONE	FINAL BACKFILL MATERIAL
PERCENTAGE PASSING				
6"			100	Native material which contains no sod, vegetation, rocks larger than 3" diameter, asphalt or concrete chunks, etc.
3"	100		80 – 100	
2"	90 – 100		70 – 100	
1"	70 - 90		50 – 100	
½"	51 – 75	100	30 – 100	
#4	31 – 65	95-100	25 – 80	
#16	16 – 40		16 – 50	
#50		10 - 40		
#200	2 - 12	7-15	10 – 50	

4.4.2.4 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 OSHA requirements. 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.

- 4.4.2.5 PIPE LAYING AND BEDDING. Pipe will be carefully inspected in the field by the Contractor and the City'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 City'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 upgrade unless otherwise authorized by The City's Representative.

In general cases, 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 lying

shall be removed and re-laid to the proper grade and alignment.

A. REQUIREMENTS FOR LINE AND GRADE. All drainage pipe shall be installed to the defined line and grade within the following limits.

- o 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 City's Representative. Any variations shall not result in a level or reverse slope installation.
- o 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 installing precast bases..
- o All 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 six inches in least dimension) Near the trench bottom shall be removed and the hole refilled with approved backfill in accordance with Table 4.1.

Water pipe shall not be deflected at the joint more than a maximum of one degree, or as per the manufacturer's recommendation.

Drainpipe 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 an air-tight, 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.

If a mega lug retainer system cannot be used, a concrete thrust block system can be substituted, if approved by the Water Department, 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 City'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 City's Representative. The plugs and caps shall also be tied to the pipe with restraining joints.

E. SERVICE LINES. All service lines shall be installed in accordance with 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 City's Representative during and after laying. Pipe ends must be sealed airtight when left over night or weekends.

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 installation as determined by the City'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 transit AC pipe shall not be cut and should be removed and replaced with ductile or PVC pipe.

I. END PREPARATION. Pipe ends shall be cut square, deburr, and beveled in accordance with the pipe manufacturer's recommendations.

J. PUSH-ON JOINTS. The push-on joint shall be a single elastomeric gasket 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 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:

- o 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.
- o A sealing gasket.
- o A follower gland with bolt holes matching those in the fitting.
- o 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 City's Representative as per the requirements on the standard details (95% of maximum dry density as determined by ASTM D-1557 or AASHTO T-180 method).

Bedding materials shall conform to the requirements of Table 4.1 of these standards and shall be free from roots, sod, vegetation or other 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 4.1, under "bedding material".

- 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 City'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 4.1 or as approved by The City'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 percent of maximum dry density for granular soils or ninety (90) percent of maximum dry density for silty/clay soils. In shoulders and other street right-of-way areas, the in-place density shall be a minimum of ninety percent of the maximum dry density.

A. INITIAL BACKFILL PROCEDURE. (Pipe Zone) Previously screened backfill of selected material, which shall conform to the requirements of Table 4.1 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 twelve (12) inches thick or less with materials free from roots, vegetation or other deleterious material, or rocks, stones or boulders larger than six inches in the greatest dimension.

The material shall be mechanically compacted with appropriate vibrating compaction equipment.

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 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. 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.

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 City's Representative.

C.1 Vibrating rollers shall consist of a self-propelled roller with a vibrating steel drum of at least one-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 comp active 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.

D. FLOWABLE BACKFILLING. For trenches under pavement, sidewalk, curb and gutter, and in all existing City streets, flowable backfill may be used (unless otherwise directed by The City's Representative) for backfill and shall be in conformance with the standards for "Flowable Fill" as described below. Flowable fill shall not be used as backfill for water main trenches without prior approval of the City's Representative. Flowable fill shall be discharged from the ready-mix truck by reasonable means into the trench to be filled.

The fill shall be brought to an elevation equal to the bottom of the road base and shall be finished level to provide a uniform surface. Flowable fill shall not take the place of road base or asphalt in the roadway section.

When surface restoration cannot take place promptly in existing City streets or in other areas where safety is a concern, the flowable fill may be extended to the bottom of the surface course and a temporary driving surface installed. When the permanent surface is installed the temporary surface and flowable fill shall be removed to

the level of the bottom of the road base, and the roadway structure properly restored in accordance with these standards.

Flowable fill:

D.1 Portland Cement - Type II or IL (10) HS.

D.2 Fly Ash - ASTM C-618, Class F, except loss on ignition shall not exceed three (3) percent maximum and shall come from a source approved by the City Representative.

D.3 The coarse and fine aggregate for flowable fill shall be natural material consisting of mineral aggregate particles meeting the following requirements.

SIEVE SIZE	PERCENT PASSING
$\frac{3}{4}$ "	100
200	0 - 10

D.4 Mix Design - shall meet the following:

Minimum compressive strength (28 days) 50 PSI
Maximum compressive strength (28 days) 150 PSI
Maximum fly ash per cubic yard 100 lb
Minimum cement per cubic yard 50 l
Minimum Slump 6 in.
Maximum slump 10 in.

4.4.2.7 SPECIAL REQUIREMENTS FOR CUTTING INTO NEW ROADS:

- o Geotechnical Investigation and Report: In areas where a geotechnical investigation is required before development, the recommendations of the geotechnical report shall be followed and verified. The

requirements outlined previously in this chapter are only a minimum. (Ord. 2006-24, 7-5-2006)

- o Final Soils Submissions: All subdivisions and planned unit development projects shall submit a final soils engineering and engineering geology report in accordance with the applicable building-related code(s). (Ord. 2007-24, 8-15-2007)
- o No Cut Policy: When a street has been newly improved, there will be a "no cut" policy in force that will not allow the new asphalt to be cut to install utilities or for other reasons for a period of two (2) years. After the two (2) year period, all cuts must meet the following standards:
 1. Flowable backfill (1 bag mix) in trench (at city's discretion).
 2. Ten foot (10') minimum patch width (2 foot minimum each side of trench).
 3. Saw cut edges of patch.
 4. Patch must be machine-laid hot mix (cold mix may be used temporarily if hot mix cannot be obtained then removed and replaced with hot mix when it is available).
 5. Patch shall be three inches (3") asphalt over six inches (6") granular base meeting city standards.
 6. Seal the saw cut edges with a rubberized crack fill material.
- o No Cut Exceptions: Exceptions to the "no cut" policy during the first two (2) years may be made on a case-by-case basis. The following standards will apply where exceptions are granted:

1. Flowable backfill (1 bag mix) in trench (at city's discretion).
 2. Ten foot (10') minimum patch width 2' foot minimum each side of trench)
 3. Saw cut edges of patch.
 4. Patch must be machine-laid hot mix; cold mix may be used temporarily if hot mix cannot be obtained, then removed and replaced with hot mix when it is available, or at the discretion of the City Representative.
 5. Patch shall be three inches (3") asphalt over twelve inches (12") granular base meeting city standards.
 6. Fill the saw cut edges with a rubberized crack fill material.
- o Flowable Backfill Installation Exceptions: In lieu of backfilling all trenches cut into new city streets with flowable backfill as set forth above, contractors, utility companies or any other entity working on new city streets may backfill any trench according to the specifications set forth in Section 4.3 of these Standards provided that such contractor, utility company or other entity working on new city streets provides the following:
 1. A written warranty in a form approved by the city providing that if such trench compaction subsides, sinks, or otherwise fails for any reason, or the pavement over the compacted trench cracks, during the life of said trench, that the contractor, utility company, or other entity will repair and recompact said trench. Such repair shall be completed at no cost to the city according to the standards set forth in section 4.3 of this chapter. Repairs shall be completed within thirty (30) days after receiving

written notice that such trench has failed. However, in an "emergency", which is defined as the failure of any trench due to a natural or artificial condition and which poses an eminent risk to persons or property, such contractor, utility company or entity whose trench failed will undertake all reasonable steps to protect persons or property from further damage, within twenty four (24) hours after receiving notice from the city. Such steps shall include, but are not limited to, erecting barricades, warning lights, lanterns, flares, or other devices to alert the public to the potential hazard. Thereafter, such contractor, utility company or entity shall commence repairs to the affected trench as soon as practicable according to the standards set forth herein; and

2. Any contractor, utility company, or entity incapable of providing evidence of a net worth in excess of one million dollars (\$1,000,000.00) must, in lieu thereof, also post a cash bond for the estimated and reasonable cost to repair said trench established by the City's Representative. The city will retain said cash bond for two (2) years following completion of the trench work. If, upon inspection by the City's Representative or inspector after the expiration of two (2) years, it is discovered that the trench is still intact and has not subsided, sunk, or otherwise failed for any reason, the city will release such bond.

- o Conflicts: Where the provisions of this section conflict with the provisions of other sections, the provisions of this section shall take precedence.

- o Concrete Surfaces: The subbase for concrete surfaces shall be sprinkled just before placing the concrete. Joints and surfaces shall be made to match the original surfaces. The thickness of concrete shall be equal to the adjacent concrete, but in no case less than six inches (6") thick.

The mixing, cement, water content, proportion, placement, and curing of the concrete will be approved by the public works director. In no case shall the concrete have less compressive strength than three thousand (3,000) pounds per square inch (psi) at the end of twenty-eight (28) days.

- o Concrete Base, Bituminous Wearing Surfaces: This type of surfacing shall be constructed as outlined in Chapter 3 of this title.
- o Gravel Surfaces: Trenches excavated through gravel-surfaced area, such as gravel roads and shoulders and unpaved driveways, shall have the gravel restored and maintained as described in this chapter, except that the gravel shall be a minimum of one inch (1") more than the thickness of the existing gravel. (Ord. 2006-24, 7-5-2006)

4.4.2.8 TRENCHES ON HIGHWAYS AND STREETS. No work of any kind shall be performed in any public right-of-way without first obtaining the proper permits. Wherever any trenches will be in, or must cross any State road or any City road, alley or drainage way, The Contractor, or other responsible party, shall obtain any and all excavation and encroachment permit 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/or the City.

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 City's representative. No scarify-tooth cuts, back-hoe, or bucket rips will be allowed.

All backfilled trenches in roadways shall be patched with hot-mix asphalt within 48 hours of initial excavation, unless otherwise directed by The City's Representative. All backfill shall be in accordance with Table 4.1 of 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 Section 4.7 of 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 Developer and/or Contractor shall be responsible for maintenance of the trench, patch, and related work for a period of twelve (12) months from the date of completion (See Section 2 of these Standards).

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 City'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 City's 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 overnight.

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 TV, 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.

4.4.2.9 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 Water Department.

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 Department. 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 City's Representative and Water Department.

4.2.2.10 SPECIAL REQUIREMENTS.

A. CONNECTIONS TO EXISTING FACILITIES - DRY TAPS. All connections to existing facilities shall be approved by The City Water Department. 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 Water Department 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 Department representative. Valves shall not be operated without a Water Department representative present. Existing facilities shall not be shut down for connections to new facilities without prior Water Department approval. In no case shall an existing pipeline be shut down for a total of more than twenty-four (24) hours (a maximum of three (3), eight-hour periods).

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 Water Department and shall be approved before The Contractor will be allowed to proceed. The Contractor shall notify, by a method approved by The Water Department, all affected Water Department 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 Department representative. If the water will be shut off for an extended period of time, the Water Department may require the Contractor to supply water for the Water Department's customers.

B. CONNECTION TO EXISTING FACILITIES - WET TAPS. (Steel and Steel Composite Mains). The Contractor shall furnish and install, at his sole cost and expense, all tapping fittings and valves for all wet taps on existing City water pipelines. The Contractor shall notify The Water Department 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 Department.

All wet taps to existing City water pipelines shall be made by the City Water Department at the sole expense of the Contractor requesting the work. The Contractor shall also provide all necessary equipment, labor, and appurtenances necessary to complete the job. The wet tap materials shall be obtained from a source pre-approved by The Water Department.

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:

- o Soil Proctor - One determination for each significant change in soil type as necessary to provide required compaction testing. Tests shall be ASTM D1557 (Modified Proctor) or ASTM D698 (Standard Proctor), or the equivalent AASHTO T180 or T99 methods, as appropriate for fine-grained or coarse-grained soils.
- o 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 the pipe zone.

One test per two (2) feet of depth measured from the bottom 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 City'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 STORM DRAIN LINE TESTING AND ACCEPTANCE. The Contractor shall test all storm drain lines prior to final

acceptance. Testing shall be done in the presence of the City Representative. Prior to testing, all storm drain lines should 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. All trench compaction testing shall be completed and approved prior to performing air and deflection tests. Storm drain lines and manholes shall be tested for leakage and alignment 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 City's Representative shall be remedied by the Contractor. After cleaning and inspection have been completed, the line shall be tested for leakage.

B. AIR TESTING. The air test shall be performed on storm drain lines as directed by the City's Representative. This test applies to all types of pipe. When concrete pipe is used, it shall be prewetted 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 94 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.

Pipe Diameter	Time Min	Sec	Pipe Diameter	Time Min	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. The Contractor may be required 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 storm drain 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 pip, 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.

Diameter (Inches)	Maximum Drop in Head in a 4-ft. Diameter Manhole (Non-taper sect.) per 100 ft. of pipe	Maximum Allowable Leakage (exfiltration) (Gallons/Hour/100ft.)
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 storm drain and shall assist the City's Representative 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 City's Representative is satisfied that the leakage requirements have been met. All repair

methods and materials used shall be approved and accepted by the City's Representative. "Furnco's" shall not be used.

- D. MANDREL. The contractor may be required to test storm drain line 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 storm drain lines. Any sections of storm drain not passing the mandrel shall be uncovered and repaired by the Contractor. The Contractor shall re-round or replace the storm drain to the satisfaction of the City's Representative. 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 grade and compacted.

- E. INSPECTION AND FLUSHING. Prior to final acceptance of each section of storm drain lines, all lines shall be flushed by the Contractor. All dirt and debris shall be prevented from entering the existing storm drain system by means of water-tight plugs or other suitable methods.

Prior to the placement of road base within the project, the City's Representative will carefully inspect all storm drains and appurtenances by means of camera and video. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the storm drain lines and manholes shall be left smooth, clean, and free from any obstructions throughout the entire line. Prior to acceptance of the storm drain system, all manhole rings and covers shall be adjusted to finished grade, concrete

collars installed with markings indicating size and flow direction of storm drain line.

- F. MANHOLE LEAKAGE TEST. Sewer manholes located in areas of groundwater or probable flooding or if their water tightness is suspect, as determined by the City's Representative, shall be tested for leakage prior to acceptance. The contractor shall perform all testing. Allowable leakage shall be one gallon per hour per manhole. 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 City Water Department Representative. 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. All pressure testing shall be accomplished prior to the placement of asphalt above the section being tested and after the installation of ALL underground utilities. 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.

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. Each valve 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 City Water Department, 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 Water Department.

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 City's Water Department or the City's Representative.

- B. BACTERIAL TESTING. After the pipe has been pressure tested in accordance with these standards, each valved section, unless otherwise directed by the Public Works Department, shall be verified negative for the presence of bacteria.
- C. OPERATIONAL INSPECTION. At the completion of the project and in the presence of The City's Representative, 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.
- D. TEST RESULTS AND CERTIFICATES OF COMPLIANCE. Test results shall be submitted for pressure, bacteria, and operational testing in accordance with the current City

Water Department requirements. Certificates of compliance from material suppliers may be required, at the option of The City's Representative, for any materials not specifically covered herein.

4.4.3.4 SEWER SYSTEM TESTING AND ACCEPTANCE. All sewer improvements shall meet Ash Creek Special Service District standards and requirements. Contractor shall coordinate with Ash Creek Special Service District for testing and acceptance of sewer improvements.

4.5 ROADWAY CONSTRUCTION This subsection covers roadway construction, including sub-grade, sub-base, road base, 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 approved plans do not purport to show all the details of the work. The plans are intended to illustrate the character and extent of work required, and therefore, they may be, if necessary, supplemented or revised as the work progresses.

The Contractor shall keep the most current set of approved plans available on the job site at all times. 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 City's Representative. If, at any time, The Contractor fails to comply with these provisions, The City's Representative will immediately notify The Contractor of such non-compliance. If the Contractor fails to remedy the unsatisfactory maintenance within twenty-four hour after receipt of such notice, the City's Representative may immediately proceed to cause correction(s) to the job site and adjoining areas. The entire cost of this corrective maintenance will be billed to The Contractor and shall be paid in full prior to The City's acceptance of the work.

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 entire 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 sub-grade, finished sub-base, and finished road base 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, and TBC as indicated on the approved plans. Grade stakes with hubs set to the finished grade of the sub/grade shall be painted appropriately. Stakes with hubs set to the finished grade of the sub*base or road base 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 the professional engineer whose seal is on the approved plans.

The Contractor constructing the facilities 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 City. At no time shall a permanent monument be removed without prior authorization by the City Engineer. When construction work encounters such monuments, the 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 sub-grade, sub-base, and road base 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 degrees F. (-18 to 71 degrees C.).

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 ft (4.5 MM) ACCURACY
Cross-slope resolution	0% slope or 0.01 ft/10 ft (3mm in 3m) 1
Cross-slope system accuracy	0.02 t/10 ft (6mm in 3 m)

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 City’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 3.2.6 and where otherwise outlined in these specifications.

The structural details shown on the plans and/or Standard Drawings, and Table 4.2 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, Caltrans). Required subgrade soil properties shall be obtained from an on-site geotechnical investigation. Required traffic design traffic information is provided in Table 4.2. When, in the opinion of the City Engineer, the traffic information listed is inappropriate for the street under consideration the Traffic Index will be adjusted accordingly.

TABLE 4.2
Minimum Roadway Structural Requirements

Classification	Traffic Index	(3)(4) Roadway Minimum Asphalt Pavement (inches)	(4) Required Roadway Road-Base (inches)	Sidewalk Minimum Concrete Thickness (inches)	Sidewalk Minimum Road-Base Thickness (inches)	Driveway Minimum Concrete Thickness (inches) within R/W	Driveway Minimum Road Base Thickness "residential" (inches) within R/W
Residential Access 37	5	3	6	4	4	6	6
Residential – Standard 50	5	3	6	4	4	6	6
Residential – Collector 60	5.5	3	6	4	4	6	6
Major Collector- 66	6	3	8	4	4	6	6
Minor Arterial 80	7	4	8	4	4	8	8
Major Arterial 106	8	5	10	4	4	8	8
Commercial Local	10	4	10	4	4	8(1)	8

Industrial Local	10	5	12	4	4	8(1)	8
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(1) #4 rebar to be placed three inches above the bottom of concrete, spaced 12 inches on center each way

(2) Thickness may vary base upon structural section design by a registered professional engineer experienced in flexible pavement design. Minimum values are shown above.

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 one foot beyond the proposed construction limits. This includes roadways, curbs & gutters, and 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 six inches (6”) unless otherwise recommended by the geotechnical firm approved by the City representative.

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 City’s Representative for approval prior to performing any work in the areas being addressed.

Uniform pervious soils that allow the immediate penetration of water to a depth of one foot will not require scarifying and processing unless a condition previously stated requires it. When scarifying and processing are not required, the moisture content of the top one foot of the subgrade material shall be brought to not less than two percent of optimum by the addition of water on the surface, and the material shall be compacted by approved equipment to the specified compaction requirements.

When scarifying and processing, the roadbed shall be loosened to a depth of at least six inches (6”), then alternate

blade moistening and rolling will be required to provide a smooth, even, and uniformly compacted course true to cross-section and grade. Moisture content at the time of processing and testing shall be not less than two percent of optimum. All rocks larger than four inches (4") in diameter shall be removed.

4.5.5.2 TOLERANCES. When subbase material is placed on the subgrade the subgrade tolerance shall not vary more than 0.10 feet from the specified grade and cross-section, however, when untreated base course or recycled aggregate materials (RAM) 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. Subbase for all roadways and associated areas shall consist of select materials, either natural or crushed. Subbase material shall meet the physical properties shown in Table 4.3.

Table 4.3
Subbase Physical Properties

Properties	Specification		Test Method
	Max	Min	
Liquid Limit	Non-plastic	--	AASHTO T 89
Plastic Index	Non-plastic	--	AASHTO 90
Aggregate Wear	<50%	--	AASHTO T 96
Gradation			AASHTO T 11
			AASHTO T 27

Prior to delivering any subbase to any site, the supplier shall submit, in writing, a job-mix gradation to the City Engineer for approval. The job-mix gradation shall have target values for the percentage of aggregate passing each specified sieve based on the dry weight of the aggregate. Target values shall fall within the band limits shown in Table 4.4.

Table 4.4
Subbase Aggregate Gradation

Gradation Limits			
	Target Value Range		
Sieve	Class 1	Class 2	Allowable Deviation from Target Values
6"	100	- -	- -
3"	90 - 100	100	± 12
2"	80 - 100	90 - 100	± 12
1"	70 - 90	70 - 90	± 11
½"	51 - 75	51 - 75	± 11
#4	31 - 65	31 - 65	± 9
#16	16 - 40	16 - 40	± 7
#200	2 - 12	2 - 12	± 3.0

Annual job-mix gradations shall be submitted in writing to the City Engineer 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.

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 inches compacted thickness for Class I- and six 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 percent below optimum. However, caution shall be used to avoid overwatering 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 (95%) of maximum dry density as determined by ASTM D1557 or AASHTO T-180. Subbase tolerances when compacted shall not vary more than 0.05 feet from the specified grade and cross-section

4.5.6.1 SUBBASE ACCEPTANCE TESTING REQUIREMENTS AND TOLERANCES. Testing documentation shall fully address the requirements of these standards. The following will be required for testing and acceptance of subbase:

A. One moisture/density test per seven thousand square feet (7,000 SF) of roadway, or fraction thereof.

B. One thickness test hole per five thousand square feet (5,000 SF).

C. One gradation test per fifteen thousand square feet (15,000 SF) of roadway, or fraction thereof. If the gradation results are outside of the allowable deviation shown in Table 4.6, the following requirements apply.

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 percent (25%) 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.

The following are the minimum values for roadway Subbases.

o The minimum acceptable SE value shall be twenty-two (22).

- o The minimum acceptable R-value shall be sixty (60). (1)
- Or
- o The minimum acceptable CBR value shall be forty (40). (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 compacted within 1% of optimum moisture content, 5 lifts, 56 blows per lift, with 10-pound hammer, 18-inch drop.

4.5.7 UNTREATED ROAD BASE - ONE INCH AND THREE-QUARTER INCH. All gravel pits supplying aggregate shall be UDOT-approved pits.

Untreated base course for all roadways and associated areas shall consist of select materials, natural and/or crushed, that meet the physical properties shown in Table 4.5.

Table 4.5
Untreated Base Course Physical Properties

Properties	Specification		Test Method
	Max	Min	
Dry Rodded Unit Weight, pcf	--	75	AASHTO T 19
Liquid Limit	Non-plastic	--	AASHTO T 89
Plastic Index	Non-plastic	--	AASHTO 90
Aggregate Wear	40	--	AASHTO T 96
Gradation	Table 4.6		AASHTO T 11
			AASHTO T 27
Quantitative Analysis of Gypsum	2	--	S-3171-96
CBR with a 10 lb surcharge measured at 0.20 inch penetration	70	--	AASHTO T 193 compacted within 1% of optimum

			moisture content, 5 lifts, 56 blows per lift, with 10-pound hammer, 18-inch drop
Two Fractured Faces	--	50	AASHTO T 335

Prior to delivering any untreated base course to any site, the supplier shall submit, in writing, a job-mix gradation and a standard aggregate gradation plot to the City Engineer for approval. The job-mix gradation shall have target values for the percentage of aggregate passing each specified sieve based on the dry weight of the aggregate. Target values shall fall within the band limits shown in Table 4.6 and provide a uniform curve when plotted on a standard aggregate gradation chart. The City Engineer 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.

Table 4.6
Untreated Base Course Gradation

Gradation Limits			
Sieve Size	Target Value Ranges		Allowable Deviation from Target Values
	1" Band	3/4" Band	
1 inch	100	--	± 11
¾ inch	--	100	± 11
½ inch	79 - 91	--	± 11
⅜ inch	--	78 - 92	± 10
No. 4	49 - 61	55 - 67	± 9
No. 16	27 - 35	28 - 38	± 7
No. 200	7 - 11	7 - 11	± 3.0

Annual job-mix gradations shall be submitted in writing to the City Engineer 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.

The untreated base course placed on projects during one day's operation shall come from a single source. Intermixing from more than one source will not be permitted.

Untreated base course shall be placed in layers compatible with the equipment and not exceeding eight (8) inches in non-compacted thickness. Where the required thickness is more than eight inches, the untreated base course shall be spread and compacted in two or more layers of approximately equal thickness. However, if vibratory compaction equipment of a type approved by The City's Representative is used, and the requirements for density and moisture content are complied with, the non-compacted thickness of any one layer may be increased to ten (10) inches. Each layer shall be compacted for the full width and depth by mechanical means. When mixing, moistening, and placing untreated base course, the moisture content shall be not less than two percent (2%) 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 untreated base course shall be compacted to not less than ninety-five percent (95%) of maximum dry density as determined by ASTM D-1557 or AASHTO T-180 method D. Untreated base course 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 asphalt pavement is placed.

When the untreated base course 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 untreated base course moisture, structural integrity, and finish, to the finished tolerances of this subsection.

4.5.7.1 UNTREATED BASE COURSE ACCEPTANCE TESTING REQUIREMENTS AND TOLERANCES. Testing documentation shall fully address the requirements of these standards. The following will be required for testing and acceptance of untreated base course:

- o One moisture/density test per seven thousand square feet (7,000 SF) of roadway, or fraction thereof.
- o One thickness test hole per five thousand square feet (5,000 SF).
- o One gradation test per fifteen thousand square feet (15,000 SF) of roadway, or fraction thereof. If the gradation results are outside of the allowable deviation shown in Table 4.6, the following requirements apply.

One sand equivalent (SE) value for every gradation outside the allowable tolerance. A CBR or R-value shall be performed on twenty-five 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.

The following are the minimum values for roadway Subbases.

- The minimum acceptable SE value shall be twenty-two (22).
 - The minimum acceptable R-value shall be seventy-six (76). (1)
- or
- The minimum acceptable CBR value shall be seventy (70). (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 compacted within 1% of optimum moisture content, 5 lifts, 56 blows per lift,

with 10-pound hammer, 18-inch drop.

- 4.5.8 PRIME COAT. Prime coat is required on all roadways unless otherwise approved by the City. This work shall consist of preparing and treating an existing aggregate base with bituminous material and blotter material, if required, in accordance with these specifications and in conformity with the lines shown on the plans or established by The City's Representative. The type and grade of bituminous material shall be MC-70 liquid asphalt, unless otherwise approved by the City's Representative.

The prime coat may be waved with an additional 1/2 inch in the thickness of the asphalt.

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 from 0.05 to 2.0 gallons per square yard with uniform pressure and an allowable variation from any specified rate not to exceed 0.02 gallon per square yard. Distributor equipment shall include a tachometer, pressure gages, and accurate volume measuring devices or a calibrated tank, and thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars, adjustable laterally and vertically.

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 50 F (10 C), or when weather conditions, in the opinion of The City's Representative, would prevent the proper application of the prime coat. The surface upon which the bituminous prime coat will be placed shall conform to the established lines and grades, shall be smooth and uniform and shall be compacted to the required density with the optimum moisture content at plus or minus two percent.

If, for any reason, the required density and/or moisture deteriorate

between the time the gravel course was compacted and the time the prime coat is placed, the surface shall be re-compacted and/or moisture conditioned to the required density and moisture content.

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 City’s Representative. At the time of placement, the temperature of the liquid asphalt shall be uniform and not less than 120 degrees F (49 degrees C) nor more than 180 degrees F (82 degrees C).

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 City’s Representative to areas where the prime coat has been damaged, and loose or extraneous material shall be removed.

Sand blotter material shall meet the following requirements. The material may be accepted in the stockpile at the source. Blotter shall be free of organic matter and clay balls and meet the following gradation limits shown in Table 4.7.

Table 4.7
Sand Blotter Gradation

Gradation Limits

Sieve Size	Percent Passing by Weight	
	Min	Max
½ inch	100	100
No. 4	90	100
No. 16	30	75
No. 200	0	12

Liquid asphalt shall not be sprayed upon adjacent pavements, that portion of the traveled way being used by traffic, structures, railings and barriers, markers, adjacent property and improvements, and other roadway improvements or facilities not mentioned herein.

4.5.9 TACK COAT. This work shall consist of preparing and treating an existing bituminous or concrete surface with asphaltic emulsion in accordance with these specifications and in conformity with the lines shown on the plans or established by The City's Representative.

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 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 from 0.05 to 2.0 gallons per square yard with

uniform pressure and with an allowable variation from any specified rate not to exceed 0.02 gallon per square yard. Distributor equipment shall include a tachometer, pressure gage(s), and accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars, adjustable laterally and vertically.

Application of tack coat may occur only when the surface and air temperature is 50 degrees F (10 degrees C) 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 (24 degrees C) or more than 130 degrees F (54 degrees C).

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 City's Representative.

Liquid asphalt shall not be sprayed upon adjacent pavements, structures, railing, barriers, markers, adjacent property improvements, and other facilities not mentioned herein.

4.5.10 DENSE-GRADED ASPHALT. A Marshall mix design must be submitted and approved, along with certification from an independent lab prior to the placement of any asphalt.

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.

4.5.10.1 MIX DESIGN. Annual mix designs with independent lab certification shall be submitted in writing to the City Engineer for approval two weeks prior to the first job each calendar year, or upon selection of new aggregate sources.

4.5.10.2 RECYCLED ASPHALT PAVEMENT (RAP). Recycled asphalt pavement will be permitted for use in mix designs from carefully processed and uncontaminated stockpiles. The maximum percentage allowed will be 20% as determined from the aggregate contribution from the RAP to the overall mix. Any mix proposed with a RAP contribution > 10% must drop to the next lower grade for virgin liquid asphalt used for the mix.

Examples:

- o A mix design is desired for a Category I roadway using an AC, 30, and there is a desire to use RAP at 15%. This is acceptable so long as the virgin liquid asphalt is changed to an AC-20 or a PG 64-22
- o A mix design is desired for a Category II roadway using a PG 64-22, and there is a desire to use RAP at 10%. This is acceptable with no change to the proposed virgin liquid asphalt

4.5.10.3 RELATED WORK. Work related to asphalt concrete pavement shall include surface preparation, prime coat, tack coat, transporting, placement, compaction, and finishing of asphalt mixture as required. Work zone traffic control shall be in accordance with the requirements of Section 2.5 of these specifications.

4.5.10.4 ASPHALT CEMENT. Asphalt cement shall be viscosity graded or substituted by performance graded asphalt binder as follows

Viscosity Grade Meeting AASHTO M 226-80, Table 2 and Table 4.8 below	AC-10	AC-20	AC-30
Performance Grade meeting AASHTO M 320 Requirements and Tables 4.9, 4.10, and 4.11 below	PG 58- 28	PG 64-22	PG 70-16

Sampling and testing of viscosity graded asphalt cement shall be in accordance with AASHTO M 226-80, section 4. Sampling and testing of performance graded asphalt binder shall be in accordance with AASHTO M 320, sections 6 and 7.

Table 4.8
Viscosity Graded Requirements

Viscosity Grading	AC-10	AC-20	AC-30
Viscosity: 140° (60°C) poises	1,000 ± 200	2,000 ± 400	3,000 ± 600
Viscosity: 275°F (135°C), Cs- minimum	250	300	350
Penetration: 77°F (25° C), 100g, 5 sec-min.	80	60	50
Flash Point: COC, C(F)-minimum	219(425)	232(450)	232(450)
Solubility in trichloroethylene: percent-minimum	99	99	99
Tests on residue from thin-film oven test:			
Loss on heating: percent - maximum (1)	0.5	0.5	0.5
Viscosity: 140°F (60°C), poises- maximum	4,000	8,000	12,000
Ductility: (77°F (26°C), 5cm per minutes), cm-minimum	75	50	40
Spot test (when and as specified (2) with:	Negative for all grades		
Standard naphtha solvent			
Naphtha-Xylene-solvent, % Xylene	Negative for all grades		

Heptan-Xylene-solvent, % Xylene	Negative for all grades
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1. The use of loss on heating requirement is optional.
2. The use of the spot test is optional. When it is specified, the City Engineer's Representative shall indicate whether the standard naphtha solvent, the naphtha-xylene solvent, or the heptane xylene solvent will be used in determining compliance with the requirement. If xylene solvent is used, the percentage of xylene shall be indicated.

TABLE 4.9
Performance Graded Requirements, PG 58-28

PG 58-28			
Property	Test Method	Requirement	
Dynamic Shear Rheometer (Original Binder) at 58° C, G*/sinδ	AASHTO T315	≥1.00	kPa
Rotational Viscometer at 135° C	AASHTO T316	≤3.00	Pa·s
Original Binder Flash Point	AASHTO T48	≥230	°C
RTFO Residue	AASHTO T240	≥1.00	kPa
Dynamic Shear Rheometer (RTFO-Aged) at 58° C, G*/sinδ	AASHTO T315	≥2.20	kPa
Mass Change	AASHTO T240	≤1.00	%
Dynamic Shear Rheometer at 19° C, G* sinδ (PAV-Aged , 20 hours, 2.10 MPa, 100° C)	AASHTO T315	≤5000	kPa
Bending Beam Rheometer at -18° C, S	AASHTO T313	≤300	Mpa
Critical m-value at -18° C	AASHTO M320	≥0.300	
Direct Tension Test at -18° C, Failure Strain	AASHTO T314	≥1.00	%

TABLE 4.10
Performance Graded Requirements, PG 64-22

PG 64-22		
Property	Test Method	Requirement

Dynamic Shear Rheometer (Original Binder) at 64° C, $G^*/\sin\delta$	AASHTO T315	≥ 1.00	kPa
Rotational Viscometer at 135° C	AASHTO T316	≤ 3.00	Pa·s
Original Binder Flash Point	AASHTO T48	≥ 230	°C
RTFO Residue	AASHTO T240	≥ 1.00	kPa
Dynamic Shear Rheometer (RTFO-Aged) at 64° C, $G^*/\sin\delta$	AASHTO T315	≥ 2.20	kPa
Mass Change	AASHTO T240	≤ 1.00	%
Dynamic Shear Rheometer at 25° C, $G^*\sin\delta$ (PAV-Aged , 20 hours, 2.10 MPa, 100° C)	AASHTO T315	≤ 5000	kPa
Bending Beam Rheometer -12° C, S	AASHTO T313	≤ 300	Mpa
Critical m-value at -12° C	AASHTO M320	≥ 0.300	
Direct Tension Test at -12° C, Failure Strain	AASHTO T314	≥ 1.00	%

TABLE 4.11
Performance Graded Requirements, PG 70-16

PG 70-16			
Property	Test Method	Requirement	
Dynamic Shear Rheometer (Original Binder) at 70° C, $G^*/\sin\delta$	AASHTO T315	≥ 1.00	kPa
Rotational Viscometer at 135° C	AASHTO T316	≤ 3.00	Pa·s
Original Binder Flash Point	AASHTO T48	≥ 230	°C
RTFO Residue	AASHTO T240	≥ 1.00	kPa
Dynamic Shear Rheometer (RTFO-Aged) at 70° C, $G^*/\sin\delta$	AASHTO T315	≥ 2.20	kPa
Mass Change	AASHTO T240	≤ 1.00	%
Dynamic Shear Rheometer at 31° C, $G^*\sin\delta$ (PAV-Aged , 20 hours, 2.10 MPa, 100° C)	AASHTO T315	≤ 5000	kPa
Bending Beam Rheometer -6° C, S	AASHTO T313	≤ 300	Mpa
Critical m-value at -6° C	AASHTO M320	≥ 0.300	
Direct Tension Test at -6° C, Failure Strain	AASHTO T314	≥ 1.00	%

4.5.10.5 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:

- o Type and grade of material
- o Type and amount of additives used, if applicable.
- o Destination
- o Consignee's name
- o Date of shipment.
- o Truck identification
- o Loading temperature
- o Net weight or net gallons corrected to 60°F (16.6°C).
- o Specific gravity
- o Bill of lading number
- o Manufacturer of asphalt material

4.5.10.6 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. Hydrated lime shall be applied at a rate determined during the Marshall Mix Design requirements in Table 4.12, unless otherwise directed by the City Engineer. 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 pug mill or drum. The pug mill 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 (1½) 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. Spray bars for introducing the required quantity of slurry into the mixer shall be equipped with a positive shutoff.

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.

4.5.10.7 MIX PROPERTIES. in Chapter 5, Marshall Method of Mix Design, of the Asphalt Institute MS-2, 6th Edition. A minimum binder content of 5.2% shall be required for each mix design submitted for approval.

The mix design shall meet the requirements of Tables 4.12, 4.13, 4.14, and 4.15.

TABLE 4.12
MARSHALL DESIGN REQUIREMENTS

TRAFFIC CATEGORY*	I		II	
ASTM D-1559 (number of blows)	75		50	
TEST PROPERTY	MIN	MAX	MIN	MAX
MARSHALL STABILITY, LB. (ASTM D6927)	1800	--	1200	--
MARSHALL FLOW, 0.01 inch (ASTM D6927)	8	16	10	18
PERCENT AIR VOIDS	3	5	3	5

VOIDS IN MINERAL AGGREGATE (VMA)	SEE TABLE 4.13
STRIPPING TEST, AASHTO T283 ASTM D-4687 including Note 5	Shall be used to determine the required amount of hydrated lime or anti-strip admixture in the asphalt. The mix design shall have a minimum tensile strength ratio of 70 percent.

* Traffic Category I applies to arterial streets or truck routes with a

Traffic Index of six (6) or more.

Traffic Category II applies to streets with a Traffic Index of less than six (6).

TABLE 4.13
MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE (VMA)

Nominal Maximum Particle Size (1)	Design Air Voids, Percent (2)		
Inch	3%	4%	5%
3/4"	12	13	14
1/2"	13	14	15
3/8"	14	15	16.5

1) Nominal Maximum Particle Size is one size larger than the first sieve to retain more than 10%.

2) Interpolate minimum void in mineral aggregate (VMA) for design air void values between those listed.

4.5.10.8 AGGREGATE. The physical properties required for crushed rock, rock dust, gravel, stone, slag, and sand are included in this subsection and in Table 4.14. The aggregate target gradation of the mix shall meet the requirements in Table 4.15. 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 City's Representative will have the option to approve or reject the material. Organic matter, oil, alkali or other salts shall not exceed the limits indicated in Table 4.14.

- A. Coarse and fine aggregates for three-quarter (3/4) inch, Category I (NR), (see Tables 4.12, 4.14, and 4.15) mixes shall be one hundred percent (100%) crushed material (all manufactured). This is considered a non-rutting (NR) mix.
- B. Three-quarter (3/4) inch Standard and one-half (1/2) inch Standard, Category II, (see Tables 4.12, 4.14, and 4.15) mixes may contain a portion of natural (non-manufactured) coarse and fine aggregates as long as the physical properties in Table 4.14 are met.

Table 4.14
Dense-Graded Asphalt Aggregate Physical Properties

AGGREGATE PHYSICAL PROPERTIES				
TEST PROPERTY	Min	Max	Min	Max
COARSE AGGREGATE				
FRACTURED FACES AASHTO T335	95%	--	75%	--
AGGREGATE WEAR AASHTO T96	--	30%	--	30%
FINE AGGREGATE				
SAND EQUIVALENT, AASHTO T176	55	--	40	--
NATURAL SAND	--	0%	--	25%
PLASTIC LIMIT AASHTO T89/T90	--	NP	--	NP
COMBINED AGGREGATE				
QUANTITATIVE ANALYSIS OF	--	1%	--	2%

GYPSUM, S-3171-96				
DRY-RODDED UNIT WEIGHT, AASHTO T19	75 pcf	--	75 pcf	--

Table 4.15
Dense-Graded Asphalt Aggregate Gradation

Gradation Limits				
Traffic Category	I	II		Allowable Deviation from Target Values
Sieve Size	Target Value Ranges			
	3/4" Non-Rut	3/4" Standard	1/2" Standard	
3/4 inch	100	100	--	± 6
1/2 inch	74 - 99	--	100	± 6
3/8 inch	69 - 91	75 - 91	--	± 6
No. 4	49 - 65	46 - 62	60 - 80	± 6
No. 8	33 - 47	--	--	± 5
No. 16	21 - 35	22 - 34	28 - 42	± 4
No. 50	6 - 18	11 - 23	11 - 23	± 3
No. 200	2 - 6	3 - 7	3 - 7	± 2.0

4.5.10.9 ACCEPTANCE TESTING REQUIREMENTS AND TOLERANCES.
Testing documentation shall fully address the requirements of these standards. The following will be required for testing and acceptance of dense-graded asphalt:

- A. One binder content and sieve analysis test per production day, or one for every five hundred (500) tons or fraction thereof, whichever is greater. Asphalt binder content and sieve analysis determined according to AASHTO T308 and AASHTO T30

The maximum allowable deviations from the approved Marshall mix design gradation targets are indicated on Table 4.15. The maximum allowable deviation from the approved Marshall mix design asphalt binder target is +/- 0.35%.

- B. One Theoretical Maximum Density (Rice Method) test per production day, or one for every five hundred (500) tons or fraction thereof, whichever is greater.
- C. Theoretical Maximum Density (Rice Method) shall be determined according to ASTM D2041. Samples may be split from same bulk sample as those taken for determining binder content and sieve analysis.
- D. One density test per seven thousand square feet (7,000 SF) of surface area, or fraction thereof. Densities are determined in accordance with ASTM D2950, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

Acceptance Limits – Average density shall be between 92% -97%, with no single density lower than 90% or higher than 99%. Density is based on percentage of average Theoretical Maximum Density (Rice) determinations of production day samples.

- E. One core sample per nine thousand square feet (9,000 SF), or fraction thereof, unless sufficient inspection has been made by The City's Representative to verify required thickness.

In the event that the asphalt shows a tendency under traffic loading to rut, tear, or distort, or in the opinion of the City's Representative is "tender" or deficient in appearance, the asphalt pavement shall be cored and tested in accordance with AASHTO T-283 or ASTM D 4867,

including Note 5.

The asphalt pavement must possess seventy percent of the tensile strength ratio based on the approved Marshall mix design. Asphalt pavement not meeting this requirement shall be removed.

The City reserves the right to require the following Certification:

“Certification of each production day shall be submitted to the onsite inspector as soon as possible following production of dense-graded asphalt pavements. This certification must come from the independent accredited geotechnical firm who will be providing the “Final Grading Report” for the project. The certification must include start and stop times for production, as well as certification the asphalt produced contains the components and quantities as shown in the approved mix design. Any disruptions in production should be noted as well. The independent representative must be present for the entire production run and be allowed to verify any and all aspects of the asphalt production. Any asphalt produced without certification will be removed and replaced. Certification shall be on forms supplied by The City.”

4.5.10.10 UNACCEPTABLE ASPHALTIC PAVEMENT MATERIALS. In the event that the asphalt pavement fails to meet the allowable deviation for the asphalt binder content and/or gradation and/or fails to meet density requirements or it is the opinion of The City’s Representative that the asphalt pavement is deficient in quality, the laboratory air voids and VMA of the mix shall be determined according to ASTM D6926, D3203, and D2041. Corrective action shall be taken by The contractor according to the average density of the in-place material, laboratory air voids and VMA of mix, and Tables 4.16A and 4.16B.

Table 4.16A
Corrective Action Determination

Average Density	Air Voids 2 - 5% & VMA > Min.	Air Voids < 2% & VMA > Min.	Air Voids 5 - 7% & VMA > 1% above Min.	Air Voids > 7% or VMA < Min.
92 - 97%	No Action	2	1	3
> 97%	2	3	2	3
90 - 92%	1	2	3	3
< 90%	3	3	3	3

Table 4.16B
Corrective Action Required

#	Corrective Action Required
1	Slurry Seal / Chip Seal
2	1" Overlay
3	Remove and Replace

4.5.10.11 STORING, MIXING, AND SHIPPING OF PLANT MIX PAVEMENTS. Hot mix plants may be batch or drier-drum type plants (with not less than four aggregate bins).

4.5.10.11.1 STORAGE. The various natural and manufactured aggregates shall be stored separately. The various aggregate sizes shall be placed in bins which allow the material to be properly and evenly fed to the dryer to ensure a uniform flow of properly combined aggregates. When placing materials in storage bins, or when moving them from storage to the feeder, no method will be used which may cause segregation, degradation, or the intermingling of different size aggregates. Materials not meeting the graduation

requirements shall be reprocessed to comply with the requirements. All scales and meters shall be certified and sealed by the Utah Department of Agriculture, Division of Weights & Measures, annually and when the plant has been moved.

4.5.10.11.2 BATCH PLANT METHOD. The aggregates shall be dried and heated for sufficient time in the dryer so that the moisture content of the aggregate will not be greater than one percent. The dryer shall be equipped with a calibrated thermometer to determine the temperature of the aggregate leaving the dryer. The thermometer shall be accurate to the nearest 10°F (5.5°C) and shall be installed in such a manner that a fluctuation of 10°F (5.5°C) in the aggregate temperature will be indicated within one minute and be clearly read from the operator's platform.

After drying, the aggregates shall be evenly fed to screens having clear square openings to separate, classify, and quantify materials for hot storage bins. The aggregate passing these screens shall be separately stored in individual bins until proportioned into the mixer.

Each bin shall be provided with an opening to prevent overflow into adjacent bins. All overflow material shall be returned to an appropriate storage area for reprocessing.

If a substantial change is made in the cold feed to accommodate the demands of a different type of mixture, the hot storage bins shall be emptied and recharged with the correct materials.

All materials shall be proportioned by weight. The

aggregate scales shall be fully automatic, solid-state digital strain-gage transducer with a capacity exceeding one and one-quarter times the total amount of materials to be weighed in one operation.

Asphalt binder shall be weighed by a fully automatic scale having a capacity of not more than five hundred pounds (227kg) with one-pound (0.45kg) resolution for mixers with a manufacturer's rated capacity of four thousand pounds (1814kg) or less, and a capacity of not more than one thousand pounds (454 kg) with one pound (0.45kg) resolution for mixers with a manufacturer's rated capacity over four thousand pounds (1814kg).

When bag house fines or mineral filler is used, it shall be proportioned by weight or volume. The method used shall uniformly feed the material within ten percent of the required amount.

Mixing shall be done with a twin shaft pug mill-type mixer and shall be operated at the speed recommended by the manufacturer. The paddles shall be of sufficient size and quantity to deliver a uniform mixture.

The weight of the material that may be mixed per batch shall not exceed the manufacturer's rated capacity of the mixer, nor exceed an amount that will permit complete mixing of all the materials. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected by reduction in the volume of materials or by repairs to the mixing equipment before any further production will be allowed.

The entire batch shall be mixed until all the materials are thoroughly blended. The batch mixing time will begin on the charging stroke of the weight hopper dump mechanism and conclude when discharge from the mixer has started. The mixer shall be equipped with a time lock which locks the mixer discharge gate for the mixing period and actuates an indicator light visible from the operator's platform.

The aggregate and liquid asphalt drop time into the mixer shall not exceed ten seconds, and the time for mixing materials will not be less than thirty seconds per batch. If the City's Representative determines that the mixture is not thoroughly blended, and all aggregate properly coated with asphalt cement, the mixing time will be increased to produce a homogeneous material.

The weight-box housings and mixer platform shall provide safe and convenient access with properly sized gates and tracks for sampling the discharged materials.

- 4.5.10.11.3 DRIER-DRUM METHOD. When a drier-drum is used, aggregate shall be fed directly to the mixer drum at a uniform rate and monitored for combined aggregate moisture and gradation by taking belt cut samples. A minimum of one moisture content check and gradation test per day and one moisture and gradation test per five hundred tons (500 Tons) or as conditions require, shall be made. The results of these tests shall be kept on logs for review by the City's Representative. Sampling and testing may be performed by the manufacturer's properly trained

and equipped staff or by an approved testing lab. If sampling is performed by the manufacturer, five percent of the samples shall be split, and a testing firm approved by the City shall verify that the test results accurately represent the product being tested by the manufacturer.

The sample to be split may be selected at random by the manufacturer's quality control team or the City's Representative.

If the cold feed material gradation is outside the allowable mean of deviations of the approved mix design as determined in Section 4.5.24, production shall be stopped until the necessary corrections are made. If the moisture content of the cold feed reaches five percent, production shall be stopped until certified by an approved independent material testing firm under the direction of a Registered Professional Engineer, licensed in the state of Utah. This firm shall then be employed to provide continuous plant quality control and testing, and production may be resumed.

All production shall be prohibited if the cold feed material reaches seven percent moisture, without exception. During lay-down operations, if in the opinion of the City's Representative, excess moisture is present in the asphalt material, it shall be sampled and tested for moisture under AASHTO T-164-94 Note-6 or ASTM D2172-93 Note 3. Asphalt found to contain excess moisture shall be removed in its entirety and properly disposed of.

The dryer drum shall be equipped with a calibrated thermometer to determine the temperature of the mixed materials leaving the drum. The

thermometer shall be accurate to the nearest 10°F (5.5°C) and shall be installed in such a manner that changes of 10°F (5.5°C) in temperature of the mixed material will be shown within one minute and be clearly read from the operator's station.

Asphalt cement shall be measured through a meter under constant pressure with a gage indicating the pressure and temperature at all times. This metering system shall be calibrated and certified for accuracy every six months, or whenever the plant is moved.

During any day's run, the temperature of asphalt cement shall not vary more than 50°F (10°C).

If the meter loses pressure, the operator's computer shall be equipped to warn the operator or automatically shut down the system.

The aggregate feeders for each material in the mixture and for the combined aggregates shall be equipped with devices by which the rate of feed can be determined while the plant is in full operation. The combined aggregate shall be weighed on a belt scale. The scale shall be of such accuracy that, when the plant is operating between thirty and one hundred percent of belt capacity, the average difference between the indicated weight of the material delivered and the actual weight delivered will not exceed one percent of the actual weight for three two-minute runs. For any of the three individual two-minute runs, the indicated weight of material delivered shall not vary more than two percent from the actual weight delivered.

The belt scale for the combined aggregate, the

other proportioning devices for additives, and the asphalt cement proportioning percent, and one hundred percent of belt capacity, the average difference between the indicated weight meter shall be interlocked so that the rates of feed will be automatically adjusted to maintain the proper material ratios as designated by the approved mix design.

The plant shall not be operated unless this automatic system is operable and in good working condition.

The asphalt cement meters, additive feeders, and aggregate belt scales used for metering the aggregate additives and asphalt cement into the mixer shall be equipped so that the actual quantities of asphalt cement, additives, and aggregate introduced into the mixture can be determined.

Mixing shall be performed for sufficient time and at a sufficiently high temperature, so that at discharge from the mixer, the sizes of aggregates are uniformly distributed throughout the completed mixture and all particles are thoroughly and uniformly coated with asphalt cement.

Temperature of the completed mixture at discharge from the drum shall not exceed 325°F (163°C) for all dense-graded mixes.

The mixed material shall be discharged from the drum into a surge silo of not less than forty tons in capacity. The manufacturer shall also provide a means of diverting the flow of material away from the silo when starting and stopping the plant production, to prevent incompletely or improperly

mixed portions of the mixture from entering.

Paving grade asphalts shall be added to the aggregates, in both batch and drier-drum plants, at a temperature between 285°F (140°C) and 350°F (177°C). The temperature of the aggregates at the time of adding the asphalt cement shall not be less than 265°F (130°C), or more than 325°F (163°C). A thermometer with a 500°F (260°C) capacity, and accurate to 10°F (5.5°C) will be fixed in the asphalt cement feed line or storage tank at a suitable location to view when sampling the asphalt. The manufacturer will provide a suitable sampling outlet in the asphalt cement feed lines connecting the storage tank(s) to the asphalt cement meter. The sampling valve shall consist of a one-half inch (12.7 mm) or three-quarter inch (19 mm) valve constructed in such a manner that a one-quart (.95 liter) sample may be withdrawn slowly at any time during plant operations. The sampling valve shall be placed in the least hazardous location that is readily accessible.

A drainage receptacle shall be provided for flushing the valve prior to sampling. One gallon (3.8 liters) shall be drawn from the sampler prior to taking the sample.

4.5.10.11.4 ASPHALT CONCRETE SURGE AND STORAGE SILOS.

The type of conveying equipment used to deliver the hot-mix asphalt from the discharge chute on the drier-drum mixer or from the hopper under the pug mill may be either a variable or constant speed - bucket elevator, drag slat conveyor or hot material belt conveyor.

The manner in which the mix exits from the

conveyor or elevator and enters the top of the silo shall be such as to prevent segregation of the completed asphalt mixture. Properly installed, maintained, and operated systems such as rotating spreader chutes, batchers, and gob hoppers, are all acceptable segregation prevention systems. Splitter systems, or a series of baffles, may be used providing they are approved by the City's Representative.

Silos shall be cylindrical with conical bottoms providing a minimum angle of 55° and maximum angle of 70°. The gate opening in the bottom shall be sized to work with the angle of the cone to prevent center draw down resulting in material segregation.

Heated or insulated surge silos are not required; however, a heated discharge cone is preferred.

The asphalt mixture that develops lumps and hardening or chills below 250° (120°C) while the mix heats, the silo and discharge cone shall not be used.

All surge silos shall be emptied of mix at the end of each production day.

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 hours in silos with heated cones, and seventy-two 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.

- 4.5.10.11.5 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 or loading hopper from the silo.

The gates on the bottom of the silo cone shall open and close quickly. To prevent segregation, it is also necessary for the gates to open completely so that the flow of mix is unrestricted. The mix shall be delivered in evenly divided drops into the length of the truck bed. In no case shall the truck be loaded continuously by the truck driver moving forward under the silo as the mix is being discharged. Multiple drops of small quantities or dribbling mix into the haul vehicle at the end of the main delivery should be avoided to prevent segregation.

- 4.5.10.12 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-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.

4.5.10.13 ADJUSTMENT OF MANHOLE AND OTHER UTILITY COVERS.

Prior to paving and after untreated base course is placed, all manholes shall be brought to finish asphalt grade using concrete and/or expanded polypropylene (EPP) grade rings. Concrete grade rings shall be “wet set” in a bed of non-shrink grout; EPP grade rings shall be installed per manufacturer’s recommendation, including adhesives. All other utility covers shall be brought to the base grade. Damaged valve boxes, covers, grade rings, cones, flattops, risers, etc., shall be replaced at this time. Manhole cones or flattops that are more than eighteen inches below finish grade shall be raised by using risers under the cone or flattop. Existing untreated base course shall not be contaminated with soil or subbase. Backfill material around adjusted manholes and utilities shall comply with untreated base course standards meeting Section 4.5.7 of these specifications, and be compacted to ninety-five percent as determined by ASTM D-1557-78 or AASHTO T-180 Method D. When paving is complete, all utility covers shall be raised to finished grade, including concrete collars, in accordance with standard requirements.

4.5.10.14 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 (3.7 m) 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 only be used on 50' residential 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. (-18 to 71 degrees

The system shall perform to a minimum of the following specifications:

Ultra-Sonic Grade Control

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 pavers 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 City’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.

4.5.10.15 ROLLERS. Rollers shall be vibratory, steel-wheeled double-drum with a static weight of not less than 10 tons (9.10 tones) for breakdown rolling. Pneumatic-tired rollers with a minimum operating weight of two thousand pounds (907 kg) 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 (80°C). 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 backup

roller is not available, paving operations shall stop until adequate rollers are available.

4.5.10.16 WEATHER AND DATE LIMITATIONS. Asphalt shall not be placed during the period from December 1st through February 15th unless otherwise approved by the City Engineer. Paving approved during this time shall conform to winter paving requirements and policies. Minor repairs and patching will 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 4.16. The temperature requirements may be modified, but only when so approved and directed by the City Engineer. Open-graded asphalt mix shall be placed only when the air temperature is 50°F (10°C) and rising, and the surface temperature is a minimum of 50°F (10°C).

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.

4.5.10.17 SPREADING AND FINISHING. The asphalt mix shall be placed upon an approved surface by a self-propelled paver meeting the requirements in Section 4.5.10.14.

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 (121°C) 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 pavers, properly equipped to transfer the asphalt mix directly into the hopper, provided that the following conditions and requirements are strictly adhered to.

- o The windrow is properly sized, thereby insuring the delivery of the correct amount of material to the paving machine at all times.
- o The asphalt mixture shall be transferred from the windrow to the paving machine in such a manner that the materials in the pavers 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.
- o 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 City 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 (121°C) or more than 325°F (163°C), at the time the paving machine places the asphalt mixture on grade. Depending on environmental conditions and compaction requirements, the City's Representative may specify more strict temperature requirements.

Asphalt pavement courses of more than three and one-half 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 175°F (71°C) 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 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 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 feet horizontally from joints in any adjacent pass.

Existing roadway pavements to be widened shall be saw cut 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 to one and one-half 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.

4.5.10.18 ROLLING AND COMPACTING. Compaction equipment shall meet the requirements of Section 4.5.10.15 of these specifications, unless otherwise approved or required by The City's Representative.

A pass shall be one movement of a roller in either direction. 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 coverage 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 (80°C).

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 inches over the cold compacted mat. For proper compaction, the level of the un-compacted mix at the longitudinal joint must be above the elevation of the compacted mix by an amount equal to one-quarter inch for each one inch of compacted pavement. This ratio is "rule of thumb" and may vary slightly depending on the type of asphalt mix and the supplier. 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, and July 31, 1991". The following information is taken from that document.

- o Rolling from The Cold Side -It was common practice in the past to do the initial rolling of the longitudinal joint from the cold (previously placed mat) side of the joint. The major portion of the weight of the roller was supported by the cold, compacted mat. Only six inches or so of the width of the roller hung over the fresh mat, compressing the mix along the joint. The majority of the compact effort was wasted because the roller essentially was applying its compact effort to an already-compacted asphalt material.

During the time that the roller was operating on the cold side of the longitudinal joint, the mix on the hot side of the joint, and the rest of the mix in the course being laid, was cooling. Depending on the environmental conditions and the thickness of the mix being placed, the process of compacting,

the joint from the cold side often proved to be detrimental to the ability to obtain density on the whole pavement layer.

The reason often given for rolling the joint from the cold side of the joint was that this compaction method allowed the rollers to "pinch" the joint and obtain a higher degree of density. There is no evidence that this is true.

- o Rolling from The Hot Side -The most efficient way to compact the longitudinal joint is to put the roller on the hot mat and overlap the joint by a distance of approximately six inches over the cold mat. This place the majority of the weight of the compaction equipment where it is needed. The mix at the joint is still pushed into the joint area by the roller as long as the elevation of the new mix at the joint is proper. The longitudinal joint can be compacted effectively by keeping the roller on the new mix, instead of on the previously compacted mix. Any type of roller used for the breakdown rolling of the mix can be employed to compact the longitudinal joint as long as the elevation of the mix at the joint is above the level of the cold mat and the mix is still hot.

Sometimes the first pass of the roller is completed with the edge of the machine about six inches inside of the longitudinal joint. The theory behind this method of compaction is that the mix will be shoved toward the joint by the roller, and better compaction will be obtained. If the mix being placed is stable enough, the roller should not be able to move the material laterally to any significant degree. If the mix design is proper, this method of compacting the joint does not provide any advantage over moving the first pass of the roller outward one foot (from six inches inside the joint to six inches outside the joint). Rolling the mat by lapping the roller over the adjacent old pavement typically is the more efficient way to provide roller coverage for the whole pavement width.

4.5.10.19 SURFACE TREATMENT. A surface treatment shall be applied to the newly constructed dense-graded asphalt pavement within six to twelve months after completion of paving operations. The surface treatment shall be HA5, Onyx, or other surface treatment approved by the City Engineer. The surface treatment materials and construction shall meet manufacturers' recommendations and requirements. Placement of surface treatments outside of six to twelve months after completion of paving operations shall be approved by the City Engineer.

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 City Engineer. 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:

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.
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
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- 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 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 percent by weight when subjected to five 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 City's Representative before crushing operations begin. During aggregate crushing, additional stripping tests shall be furnished to The City's Representative upon request. No stripping test shall show a percent stripping greater than ten 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 4.11
GRADATION OF AGGREGATE FOR CHIP SEAL COATS

SIEVE SIZE	PERCENT BY WEIGHT PASSING	IDEAL GRADATION TOLERANCE
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	(Ideal)	(Percent)
1/2 Inch	100	
3/8 Inch	95	+/- 5
No. 4	15-10	+/- 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, striping 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 test performed for every five hundred tons of material produced or one 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 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 gradation test conducted for every five hundred tons of material. If the gradation test requirements are not met, the City'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 City's Representative will not accept any chips which do not meet all the designated specifications. No reduction in pay or other remedial terms will be allowed or negotiated.

In addition to the random acceptance samples taken at the stockpile, the City'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 4.11 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 City'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 City'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 City's Representative has full access to the testing procedure and shall deliver to The City'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 City'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 City'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 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 self-propelled, smooth-tread, pneumatic-tired rollers on the job during the chipping operations. Each roller shall weigh at least ten 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 psi. No steel wheel rollers shall be used to roll the chip seal surface treatments. Rolling speed shall not exceed ten 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 FRONT END LOADERS. The Contractor shall have on hand at least one front-end loader to load the aggregate into the dump trucks from the aggregate stockpile(s). The loaders shall have at least a two-and-one-half-yard capacity bucket.

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 the boomed 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 City'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 City'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 or collars as directed) 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 cover.

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 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 destroyed.

- 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 hip

sealed until authorization to do so have been obtained from The City's Representative. The asphalt material shall be applied at 0.32 to 0.40 gallons per square yard or as determined by the City's Representative, and at a temperature between 125 degrees to 185 degrees Fahrenheit. The exact temperature used to apply the bituminous material shall be determined by the City's Representative.

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 seconds or less. Distances between the distributor and chip-spreader shall be as close as possible, but in no case shall the chip-spreader be greater than fifty feet behind the distributor 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, as directed by The City's Representative. 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 feet during the sealing process. Operating the chip spreader at speeds that 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 with square-end shovels, 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 times. All rolling shall be completed within one 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 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 City's Representative

Bituminous material and chips shall not be spread more than one hundred 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 miles per hour for a period of not less than twenty-four hours. After the chips are set in the bituminous binder, but not earlier than the following day, or as directed by The City'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 booming will not be permitted.

At the end of seven 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 CLEAN sand (NOT DIRT) on hand or available to immediately sand any bleeding spots when requested by The City'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 City's Representative, The Contractor shall repair unacceptable areas in accordance with The City 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 City'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 most recent maintenance project specifications, or as directed by The City'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 EQUIPMENT. The equipment, tools, and machines required for the performance of the work shall be subject to the approval of The City's Representative and shall be maintained in a satisfactory working condition at all times.

- 4.7.1.1 **SLURRY MIXING MACHINE.** The slurry mixing machine shall be a flow mixing unit, capable of delivering accurately predetermined proportions of aggregate, water, and asphalt emulsion to a revolving spiraled multiblade 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.
- 4.7.1.2 **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 foot in width shall be attached to the back of the spreader box to smooth out irregularities in the slurry surface.

- 4.7.1.3 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.
- 4.7.1.4 AUXILIARY EQUIPMENT. Hand squeegees, burlap mops, shovels, and other equipment shall be provided as necessary to perform the work.

4.7.2 ASPHALT EMULSION SLURRY CONSTRUCTION METHODS.

- 4.7.2.1 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 hours, or less than twenty-four hours, in advance of said cleaning/sealing operations. If there should be any change in scheduling for a particular day production, the Contractor shall be required to notify all of the residents affected by the schedule change no later than one hour after the schedule change has been determined.
- 4.7.2.2 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.

- 4.7.2.3 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

City's Representative shall give approval that the surfaces have been properly prepared. No slurry seal material will be laid without the City Representative's approval.

- 4.7.2.4 CLEANING STREETS. Prior to the commencement of Slurry Seal operations, the Contractor shall thoroughly clean and remove all silt, 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 City'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 City's Representative to determine its fitness for receiving the surface treatment. No surface shall be slurry sealed until authorization to do so has been obtained from the City's Representative.

- 4.7.2.5 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 collars 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.

- 4.7.2.6 TEST SECTION. Prior to full production, the Contractor shall place a test section of at least sixty square yards in an area designated by the City'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 City's Representative.

- 4.7.2.7 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.

- 4.7.2.8 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 water, added as specified by The City's Representative, shall 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 minutes.

- 4.7.2.9 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 II 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 City's Representative, each application shall be thoroughly cured prior to the application of the subsequent courses.

- 4.7.2.10 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.
- 4.7.2.11 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.

4.7.2.12 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.

4.7.2.13 WEATHER LIMITATIONS. The slurry seal shall not be applied when either atmospheric or pavement temperature is below 55 degrees or above 100 degrees (Fahrenheit) determined by the City's Representative. All application shall follow the most recent contract specification administered by The City.

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 add mixtures 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 City for review and approval prior to concrete being used in City projects.

- A. PORTLAND CEMENT. ANSI/ASTM C 150, Type IL (10) HS, shall be used unless otherwise indicated, or approved by the City Engineer. Only one brand of cement shall be used throughout a project, unless otherwise approved by The City's Representative. Certified copies of the mill test for the cement shall be furnished upon request of the City'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.

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

- o 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

The combine sum of the percentage of all deleterious substances in fine aggregate listed above shall not exceed three percent by weight. Fine aggregate shall be well graded and shall range in size from fine to course within the following percentages by weight:

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

- o 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:

COARSE AGGREGATE DELETERIOUS MATERIAL
MAXIMUMS

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 coarse and fine aggregate) shall not exceed five percent by weight.

Coarse aggregate shall be rejected if it fails to meet the following test requirements:

- o Los Angeles Abrasion Test. If the percent of loss by weight exceeds ten percent at one hundred revolutions, or forty percent at five hundred revolutions.
- o Sodium Sulfate Test for Soundness. If the weighted average loss after five cycles is more than twelve percent by weight.
- o Gradation. Coarse aggregate shall be graded by weights as follows:

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

- o Aggregate Size. The maximum size of the aggregate shall be not be larger than one-fifth of the narrowest dimension between forms within which the concrete is to be encased, and in no case larger than three-fourths of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms.

For nonreinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth 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 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 City's Representative.

The maximum permissible water-cement ratio (including free moisture in the aggregate) shall be five gallons per bag of cement (0.44) for Class A and five and three-quarter 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 percent by volume (plus or minus one 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 City Engineer, 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 1.5 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 designs.
- 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. The Concrete Supplier shall obtain and deliver to The City'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. 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 Owner's 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 City's Representative.

COMPLIANCE ANALYSIS. During the course of concrete testing, the City 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. In the event that the sampled concrete is not in compliance with these standards, the supplier of the concrete will be required to pay for the "Petrographic Examination" and will no longer be allowed to supply concrete for use in any improvements for which City Standards apply until acceptable adjustments are made. IF the sampled concrete is found to be in compliance with these standards, the City will pay the cost for the "Petrographic Examination". Additional testing may be required by the City Engineer, at the supplier's expense, to determine the extent of the non-compliant concrete. All work on a project affected by the non-compliant concrete will be

suspended until the non-compliant concrete work is brought into compliance.

The “Petrographic Examination” will determine the quantity of cementitious matrix, including mineral admixture (pozzolan/fly ash) in the mix, proportions of the mix, and other properties of the sampled concrete to verify compliance with the approved mix design. The acceptability of the concrete represented by the examination shall be established by comparing the proportions determined by the examination with those indicated on the batch tickets. When this comparison shows that the pozzolan proportions are within 2% +/- of the approved mix design, the admixture proportions will be considered to be in compliance. When comparisons of other proportions of the mix indicate that the concrete is not within acceptable allowable deviation limits, the concrete may be rejected even though the pozzolan proportion is acceptable. The City may use the results of the “Petrographic Examination”, inspection records, observation of batch plant operation, compressive strength test results, or any other pertinent information to determine compliance. If any portion of a project is found to be in non-compliance, additional testing shall be required to verify full compliance of all concrete within the project.

If the City Engineer has reasonable cause, he may require removal and replacement of any concrete which has been found to be in noncompliance. (For the purpose of demonstrating the acceptability of this admixture specification, compressive strength alone shall not be considered as justification for acceptance).

Repeated violations of these admixture standards may subject the offending concrete supplier to be prohibited from providing concrete that is used in public or private infrastructure improvements within the City.

E.2 Calcium Chloride. Calcium chloride shall not be added to any concrete mix. Non-chloride accelerators may be used upon approval of the City Engineer or his Representative.

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 4.12

G. BATCH PLANT TICKET. All concrete produced and delivered to a job site within LaVerkin City 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 the City representatives, if requested.

TABLE 4.12
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.)				Reinforced structural

A	6	564	5	4" 1 ½"	4000	concrete; sidewalks; curbs & gutters; cross gutters; pavements; unreinforced footings
C	5	470	575	4"	3000	Minor nonstructural 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 City Engineer, 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 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 City Engineer. 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 City Engineer.

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:

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 monofilaments 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 public curb, gutter and sidewalk. All curb, gutter and sidewalk shall consist of air-entrained Type IL (10) HS Portland Cement Concrete and shall be constructed on a prepared sub grade 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 City'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 (2) 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. If unstable, the Contractor shall furnish and place sufficient additional gravel or other suitable material as directed by The City'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 the work, all equipment, tools, and machinery, and other appliances used in handling the materials and executing the work shall be the responsibility of the Contractor. The Contractor shall make such changes in the methods employed and, in the equipment, used as are necessary whenever the concrete being installed does not meet the specifications herein established. These methods shall include, but are not limited to, the following:

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 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 shall be thoroughly cleaned of ice or other coatings. Water shall be removed from areas to receive concrete. Reinforcement that has become too hot, due to sun exposure, in the opinion of the City Representative, will be cooled with water prior to concrete being placed. When placing concrete on earth surfaces, the surfaces sprayed with water prior to the placing of concrete or shall be covered with waterproof sheathing paper or a plastic membrane. No concrete shall be placed until the preparatory work (i.e., forms, reinforcement, etc.) has been inspected and approved by the City's Representative. shall be free from frost, ice, mud, water, and other deleterious materials.

C. CONCRETE MIXING. 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 sixty (60) 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 handling 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* 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 magnesium 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 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 City's Representative.

G. WEATHER LIMITATIONS. Concrete shall not be poured where the air temperature is lower than thirty-five (35) degrees Fahrenheit. unless approved by The City'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 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.

4.8.2.2 CONCRETE REINFORCEMENT INSTALLATION. Concrete reinforcement 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 City'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 eighteen (18) 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 4.17, 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 4.13
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 slip form/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 slip form/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 feet (100'), 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. Front and back 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 flowline 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 pan at all sewer lateral locations, a "W" in the curb pan at all water lateral locations along the curb, and an "I" in the curb pan at all irrigation lateral locations along the curb. The gutter shall not pond water. The surface of the curb and gutter shall not exceed more than one-fourth (1/4) of an inch in ten (10) feet. No part of the exposed surface shall present a wavy appearance.

- D. JOINTING.**

- o Contraction 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 City'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 square feet without contraction joints unless otherwise approved by The City's Representative.

Contraction joints may be sawed, hand-formed, or made by placing division plates in the formwork. Sawing shall be done within twenty-four 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.

- o 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 D158994, D-1751, or D-1752 and shall be furnished in a single one-half-inch-thick piece for the full depth and width of the joint.

Expansion joints in a slip-formed 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 trowel and edged.

Alternatively, 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.

- o 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 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 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 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 days after completion of the curing period.

G. BACKFILLING. At least three 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 City's Representative. The length of time may be shortened if it can be demonstrated that the concrete has reached design strength. Any concrete damaged during backfill or other operations shall be removed and replaced as directed by the City's Representative.

CONCRETE REPAIR. In lieu of removing and replacing concrete containing minor cracks, the City'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 poured against shall be saw cut in neat, straight lines and the new concrete shall be edged with a standard edging tool.

I. WEATHER LIMITATIONS. Concrete shall not be poured 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 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 City’s Representative or the Project Geotechnical Engineer. Testing documentation provided to the City’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 cylinders for each fifty cubic yards of concrete placed or portion thereof. Tests shall be according to ASTM C-31.
Air Entrainment:	Tested at beginning of placement until two consecutive loads pass. Others tests shall be taken as required. Tests shall be according to ASTM C-231.

Slump Tests:	Tested at beginning of placement until two consecutive loads pass. Others tests shall be taken as required. Tests shall be according to ASTM C-143.
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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 one hundred and fifty (150) lineal feet of curb & gutter (each side) and one test per one hundred and fifty (150) lineal feet of a combination of sidewalk and driveway or fraction thereof. Moisture content shall be at plus or minus two percent of optimum. Proper moisture shall be maintained until the

	concrete is poured. 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 161 sidewalk and driveway or fraction thereof. If sufficient observation has been made by the City's Representative to verify required thickness, the City's Representative may waive thickness testing. Said waiver must be in writing. 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 City'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 City's Representative may accept the concrete as a result of these additional tests or may require the work to be removed and replaced. The City's Representative shall make the final decision. All costs incurred in re-sampling and retesting are not the responsibility of The City. All curb, gutter or sidewalk base material not in compliance with these standards shall be removed and replaced. Any costs for testing the re-work are not the responsibility of The City.

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.

- o The gravel shall be placed deep enough to provide a minimum of six inches thickness, or to match the thickness of existing material, or to these specifications, whichever is greater.
- o 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 City's Representative. Excess material shall be removed from the premises immediately.
- o Material for use on gravel surfaces shall conform to the requirements contained within these specifications.

4.9.3 BITUMINOUS SURFACES. Where 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:

- o 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.

- o 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.
- o 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.
- o 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 two 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
SIGNAGE AND PAVEMENT
MARKINGS



5.1 INTRODUCTION	282
5.2 SURVEY REQUIREMENTS	282
5.2.1 STREET NAME SIGNS	282
5.2.2 TRAFFIC SIGNS	282
5.3 PAVEMENT MARKERS	283
5.3.1 LINE TYPES	283
5.3.2 PAVEMENT WORD AND SYMBOL MARKINGS	283
5.3.3 TRAFFIC PAINT	284
5.3.4 GLASS BEADS	284
5.3.5 TEMPORARY MARKINGS	284
5.3.6 RAISED PAVEMENT MARKERS	285

SECTION 5

SIGNAGE AND PAVEMENT MARKINGS

- 5.1 INTRODUCTION. This SECTION covers preparation and installation of street signing and application of 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.

Sign blanks shall consist of 0.08 inch thick high tensile degreased 6061-T6 aluminum alloy conforming to ASTM B 209. 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 Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways.

All street name, advisory, and regulatory signing shall be installed in such a manner as to provide adequate advance visibility for an approaching driver in accordance with the MUTCD.

- 5.2.1 STREET NAME SIGNS. Street name sign face materials shall consist of reflective high-intensity grade sheeting. The sign face colors shall be green for public streets and blue for private streets.

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 by the responsible local address coordinator prior to the fabrication and installation of any new street name signs. All street name signs shall include address coordinates.

- 5.2.2 TRAFFIC SIGNS. All advisory and regulatory traffic signing shall conform to the requirements relating to color, face material, blank material, size, and method of installation as found in the MUTCD. Traffic face sign material shall consist of reflective "high intensity" grade sheeting (FP-85 Type IIIA).

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, size, and layout of pavement markings outlined in the Manual on Uniform Traffic Control Devices for Streets and Highways shall be followed. However, in such cases where the Utah Department of Transportation standards take precedence, these standards shall be followed.

5.3.1 LINE TYPES

Solid Lines: Solid lines shall consist of a four-inch wide solid white or yellow line.

Skip Lines: Skip lines shall consist of line segments and gaps on a 3 to 1 ratio. The line segment shall be four inches wide (white or yellow line) and generally ten feet long. The gap segment shall generally be thirty feet long.

Double Lines: A double line shall consist of two four-inch wide solid yellow lines separated by a minimum four-inch wide space.

Lane Lines: Lane lines shall consist of a four-inch wide skip line, white in color. Lane lines separate lanes of traffic traveling in the same direction. A four-inch-wide 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.

Stop Bars: Stop Bars shall consist of 2-foot wide solid white lines, 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:

- o The air temperature is above forty degrees Fahrenheit.
- o The temperature of the surface to be painted is between forty and one hundred degrees Fahrenheit.
- o The surface to be painted is clean and dry, and
- o 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 hiding.

The total exterior dry film thickness shall be not less than three mils.

All permanent pavement striping (lines and crosswalks) shall be sixty mil hot-sprayed thermoplastic.

5.3.4 GLASS BEADS. Reflective glass beads shall be applied during the painting process. Apply at least 8 lb of beads per gallon of paint, the full length and width of line and pavement markings.

5.3.5 TEMPORARY MARKINGS. Temporary marking may be required until permanent markings can be properly placed. Temporary pavement markings shall be reflectorized traffic paint or other material approved by The City's Representative.

5.3.6 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 and shall be approved for use prior to application.

SECTION 6
POWER SYSTEM AND STREET
LIGHTING



6.1 INTRODUCTION	288
6.2 ELECTRICAL SERVICE	288
6.3 STREET LIGHTS AND POLES	288
6.3.1 CONTROL OF GLARE-LUMINAIRE DESIGN FACTORS	288
6.3.2 EXCEPTIONS TO CONTROL OF GLARE	288
6.3.3 OUTDOOR ADVERTISING SIGNS	289
6.3.4 RECREATIONAL FACILITIES	289
6.3.5 PROHIBITIONS	290
6.3.6 EXEMPTIONS	290
6.3.7 TEMPORARY OUTDOOR LIGHTING	291
6.4 NEW SUBDIVISION AND DEVELOPMENT CONSTRUCTION	291
6.4.1 SUBMISSION CONTENTS	291
6.4.2 ADDITIONAL SUBMISSION	292
6.4.3 SUBDIVISION PLAT CERTIFICATION	292
6.4.4 LAMP OR FIXTURE SUBSTITUTION	292

SECTION 6

POWER SYSTEM AND STREET LIGHTING

- 6.1 INTRODUCTION. All power systems and streetlights within the City limits, whether in public street, easement, subdivision, or any building project requiring street improvements, shall conform to standards set by Rocky Mountain Power as the power provider of the City, and subject to the City's final approval.
- 6.2 ELECTRICAL SERVICE. In addition to meeting all requirements of Rocky Mountain Power for the installation of power services, all subdivisions shall be required to put power services underground.
- 6.3 STREET LIGHTS AND POLES. Streetlight design and placement shall also be subject to Rocky Mountain Power's standards and the City's approval.

6.3.1 CONTROL OF GLARE-LUMINAIRE DESIGN FACTORS. Any luminaire with a lamp or lamps rated at a total of MORE than 1800 lumens, and all flood or spot luminaires with a lamp or lamps rated at a total of MORE than 900 lumens shall not emit any direct light above a horizontal plane through the lowest direct-light-emitting part of the luminaire.

Any luminaire with a lamp or lamps rated at a total of MORE than 1800 lumens, and all flood or spot luminaries with a lamp or lamps rated at a total of MORE than 900 lumens, shall be mounted at a height equal to or less the $3 + (D/3)$, where D is the distance in feet to the nearest property boundary. The Maximum height of the luminaire may not exceed 25 feet.

6.3.2 EXCEPTIONS TO CONTROL OF GLARE. Any luminaire with a lamp or lamps rated at a total of 1800 lumens or LESS, and all flood or spot luminaires with a lamp or lamps rated at 900 lumens or LESS, may be used without restriction to light distribution or mounting height, except that if any spot or flood luminaire rated 900 lumens or LESS is aimed, directed or focused such as to cause direct light from the luminaire to be directed toward residential buildings on adjacent or

nearby land, or to create glare perceptible to persons operating motor vehicles on public ways, the luminaire shall be redirected or its light output controlled as necessary to eliminate such conditions.

Luminaires used for public roadway illumination may be installed at a maximum height of 34 feet and may be positioned at the height up to the edge of any bordering property.

Luminaires used primarily for sign illumination and property illumination may be mounted at any height to a maximum of 30 feet, regardless of lumen rating.

- 6.3.3 OUTDOOR ADVERTISING SIGNS. Top-mounted Fixtures Required. Lighting fixtures used to illuminate an outdoor advertising sign shall be mounted on the top of the sign structure. All such fixtures shall comply with the shielding requirements of Section 6.3.1. Bottom-mounted outdoor advertising sign lighting shall not be used.

Outdoor advertising signs of the type constructed of translucent materials and wholly illuminated from within do not require shielding. Dark backgrounds with light lettering or symbols are preferred to minimize detrimental effects. Unless conforming to the above dark background preference, total lamp wattage per property shall be less than 41 watts.

Compliance Limit. Existing outdoor advertising structures shall be brought into conformance with this Ordinance within ten years from the date of adoption of this provision.

- 6.3.4 RECREATIONAL FACILITIES. Any light source permitted by this Ordinance may be used for lighting of outdoor recreational facilities (public or private), such as, but not limited to, football fields, soccer fields, baseball fields, softball fields, tennis courts, or show areas, provided all of the following conditions are met:

- o All fixtures used for the event lighting shall be fully shielded as defined in Section 6.3.1 of this Ordinance or be designed or

provided with sharp cut-off capability so as to minimize up-light, spill-light, and glare.

- o All events shall be scheduled so as to complete all activity before or as near 10:30 p.m. as practical, but under no circumstances shall any illumination of the playing field, court, or track be permitted after 11:00 p.m. except to conclude a scheduled event that was in progress before 11:00 p.m. and circumstances prevented concluding before 11:00 p.m.

6.3.5 PROHIBITIONS.

- o The use of laser source light or any similar high-intensity light for outdoor advertising or entertainment, when projected above the horizontal, is prohibited.
- o Electrical illumination of outdoor advertising off-site signs is prohibited.
- o Flashing, blinking, intermittent, or other lights that move or give the impression of movement are prohibited.

6.3.6 EXEMPTIONS.

- o Holiday lighting.
- o Traffic control signals and devices.
- o Temporary emergency lighting in use by law enforcement, fire departments, government agencies, or other emergency services, including all vehicular luminaires.
- o All hazard warning luminaires required by federal regulatory agencies are exempt from the requirements of this Ordinance, except that all luminaires used must be red and must be shown to be as close as possible to the federally required minimum lumen output requirements for the specific task.

6.3.7 TEMPORARY OUTDOOR LIGHTING. Any temporary outdoor lighting that conforms to the requirements of this Ordinance shall be allowed. Nonconforming temporary outdoor lighting may be permitted after considering:

- o The public and/or private benefits that will result from the temporary lighting.
- o Any annoyance or safety problems that may result from the use of the temporary lighting.
- o The duration of the temporary nonconforming lighting.

The applicant shall submit in detailed description of the proposed temporary nonconforming lighting to The Planning Commission, which shall consider the request at a duly called meeting of The Planning Commission. Prior notice of the meeting of the Planning Commission shall be given to the applicant. The Planning Commission shall render its decision on the temporary lighting request within two weeks of the date of the meeting. A failure by the Planning Commission to act on a request within the time allowed shall constitute a denial of the request.

6.4 NEW SUBDIVISION AND DEVELOPMENT CONSTRUCTION.

6.4.1 SUBMISSION CONTENTS. The applicant for any permit required by any provision of the laws of this jurisdiction in connection with proposed work involving outdoor lighting fixtures shall submit (as part of the application for permit) evidence that the proposed work will comply with this Ordinance.

The submission shall contain, but not necessarily be limited to, the following, all or part of which may be part or in addition to the information required elsewhere in the laws of the jurisdiction upon application for the required permit:

- o Plans indicating the location on the premises and the type of illuminating devices, fixtures, lamps, supports, reflectors, and other devices.
- o Description of the illuminating devices, fixtures, lamp supports, reflectors and other devices. Submissions may include catalog cuts by manufacturers and drawings.
- o Photometric data, such as that furnished by manufacturers, or similar data showing the angle of cut off or light emissions.

6.4.2 ADDITIONAL SUBMISSION. The above required plans, descriptions and data shall be sufficiently complete to enable the plan examiner to readily determine whether compliance with the requirements of this Ordinance will be secured. If such plans, description, and data cannot enable this ready determination by reason of the nature or configuration of the devices, fixtures, or lamps proposed, the applicant shall additionally submit as evidence of compliance certified reports performed and certified by a recognized laboratory.

6.4.3 SUBDIVISION PLAT CERTIFICATION. If any subdivision proposes to have installed street or other common or public area outdoor lighting, the final plat shall contain a statement certifying compliance with the applicable provisions of The City Outdoor Lighting Ordinance.

6.4.4 LAMP OR FIXTURE SUBSTITUTION. Should any outdoor light fixture of the type of light source therein be changed after the permit has been issued, a change request must be submitted to the building official for approval, together with adequate information to assure compliance with this Ordinance, which must be received prior to substitution.