CITY OF YUKON

STANDARD DRAINAGE POLICY

STANDARD DRAINAGE POLICY

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SECTION I

GENERAL DRAINAGE POLICY FOR THE CITY OF YUKON

It is the goal of this policy to establish minimally acceptable standards to be utilized in the design of storm water drainage system improvements and where required by sections herein limit storm water runoff rates after development to their historic value.

PURPOSE:

The purpose of this Drainage Standard is to establish standard practices for the design and construction of storm water drainage systems within the City of Yukon. The design factors, formula, graphs and procedures are intended for use as a minimum standard in the design of storm water drainage systems.

Methods of design other than those indicated herein should be considered where professional experience clearly indicates the minimum requirements as listed herein will not provide the level of service nor the level of protection intended. However, there should be no extensive variations from the practices established herein without the express approval of the City Engineer.

Performance Requirements: The overall goal of these standards is to provide guidance in the design, construction, operation, and maintenance of drainage system improvements. As such, an adequate drainage system could be designed, approved by the City and installed according to plan. However, if the proposed improvements do not function as intended by these standards, the site may be in violation of this standard. Therefore, the specific goal is not standards and specifications for practice, but the mandate that the improvements must function as intended. If additional control structures or improvements are needed to ensure total compliance with this standard, the design must be revised and approved, and the new measures shall be installed.

MINIMUM SURFACE DRAINAGE REQUIREMENTS FOR THE CITY OF YUKON.

(A) General Design Criteria:

(1) Drainage facilities shall be designed to provide a sufficient storm water drainage system for the conveyance of storm water runoff received from upstream and from the subject property with due allowance having been made for continued conveyance of storm water runoff from adjacent properties as the drainage basin develops.

The drainage system including streets, bridges, culverts, open channels, detention/retention facilities and etc., shall be designed to carry all probable storm recurrence intervals up to and including the 100 year storm.

(2) A dedicated drainage easement shall encompass all land lying below the water surface elevation generated by the 100-year storm event and resulting storm water runoff.

(3) Site improvement shall provide for the grading of all building pads to an elevation where the lowest finished floor elevations will not be subject to overflow from the design storm. In all developments, surface water from each dwelling lot will flow away from each dwelling to an approved collection or disposal locations as required under Section VI of this standard.

(4) Erosion and sedimentation control facilities with construction specifications and operation and maintenance procedures detailing all erosion and sedimentation control measures which are established and required maintenance during the life of the development shall be provided.

(5) No improvements shall be constructed which will increase the frequency or the depth of flooding.

(B) Existing Drainage Structures:

Existing structures within and adjoining a proposed development shall be evaluated in terms of hydraulic capacity and structural soundness. Those structures found to be structurally inadequate shall be completely removed by the developer and replaced. Structures found to be hydraulically inadequate for flow and/or for protecting property as a result of the changing runoff characteristics shall be replaced or modified to provide the required capacity and/or protection.

(C) Utilities:

All utilities located within the floodway shall be designed to prevent infiltration of flood water and to protect against washouts. Location of the utilities shall not restrict flood flows.

FLOODPLAIN DESIGNATIONS.

Any reference to official floodplain maps shall mean the highest order of floodplain designation recognized by the City of Yukon. The City Engineer will maintain an up-to-date file of such designations.

The highest available order of study shall be the basis of design unless it can be clearly shown that the subject study is in error. Contested studies shall be brought to the attention of the City Engineer.

DRAINAGE PLAN PREPARATION

(A) Preparations

(1) Plan and profile shall be drawn on sheets 24" x 36" to a horizontal scale of 1" to 20' or 1" to 40' and vertical scale of 1" to 2' or 1" to 4' (except that scales may vary on special projects, such as culverts and channel cross sections).

(2) Stationing shall proceed upstream with the North arrow pointing to the top of the sheet, or to the right.

(3) Plans for the proposed drainage system shall include property lines, lot and block numbers, dimensions, right-of-way and easement lines, floodplains, street names, paved surfaces (existing or proposed), contract limits, location, size and type of inlets, manholes, culverts, pipes, channels and related structures, outfall details, miscellaneous riprap placement, two foot (2') contour lines, flow arrows, title block.

(4) Profiles shall indicate the proposed system (size and material) with elevations, flow-lines, gradients, left and right bank channel profiles, station numbers, inlets, manholes, ground line and curb line elevations, typical sections, riprap construction, filling details, minimum permissible slab elevations adjacent to 100-year floodplains, open drainage features, pipe crossings, design flow capacities, and title block.

(5) Official floodplain designations and delineations of floodways denoting limits of permissible developments shall be shown on all preliminary plans and final plats submitted for approval wherever such plans and plats contain floodplains and/or floodway segments. In any case in which official floodplains are not delineated they shall be determined on the basis of these standards and shall be shown on all preliminary plans and final plats submitted for approval.

(B) Submittals

(1) Computations and plans to support all drainage designs shall be submitted to the City Engineer for review. The computations and plans shall be in such form as to provide the basis for timely and consistent review and will be made a part of the permanent record for future evaluation. The computations and plans shall be accompanied by the certification of a registered professional engineer licensed to practice in the State of Oklahoma. Before final approval the submitting engineer shall provide an "as built" plan accompanied with a letter of certification stating that the submitted plan complies with all governing ordinances and adopted drainage standards of the City of Yukon.

SECTION II

DETERMINATION OF STORM RUNOFF

GENERAL

Numerous methods of runoff computation are available on which the design of storm drainage and flood control systems may be based. The Rational Method will be accepted as adequate for drainage areas up to 40 acres. For larger areas, the U. S. Army Corps of Engineers, Hydraulic Engineering Circular (HEC) one (1) and two (2) shall be used.

RATIONAL METHOD OF RUNOFF COMPUTATION:

(A) Runoff Coefficient "C": The runoff coefficients shall be chosen to represent the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception. Recommended ranges for "C" are provided in Table 2.1, Runoff Coefficients for the Rational Formula by Hydrological Soil Group and Slope. The hydrological soil group is to be determined from Canadian County, Oklahoma Soil Survey provided by the United States Department of Agriculture Soil Conservation Service.

(B) Rainfall Intensity (i): The average rainfall rate in inches per hour considered for a particular drainage basis or sub-basin and selected on the basis of design rainfall duration and design frequency or occurrence.

(1) Intensity duration curves acceptable for Yukon are shown on Figure 2.1.

(2) The time of concentration is the time associated with the peak runoff from the watershed to the point of interest. Street flow shall be considered as being in an open paved channel. Manning's equation is acceptable for determine open channel and free water surface conduits flows.

An acceptable formula for use in determining overland flow is:

$\text{Time} = K\,(L^{.37}/S^{.2})$
L = Length of Flow in Feet
S = Average Slope in Feet/Foot
K = Constant for Character of Surface

Values of K:	
Pavement	.37
Bare Soil	.60
Poor Grass	.90
Average Grass	1.00
Dense Grass	1.13
Residential	0.511

An acceptable formula for determining channel flow time is:

$$\text{Time} = K\,(L^2/S)^{.385}$$

Values of K:	
Curbed Street	.0035
Concrete Lined Channel	.006
Sodded Swale	.008
Bar Ditch	.012

The time of flow in a closed conduit is the quotient of the length of the conduit and velocity of flow as computed using the hydraulic factors of the conduit.

(C) Drainage Area (A):

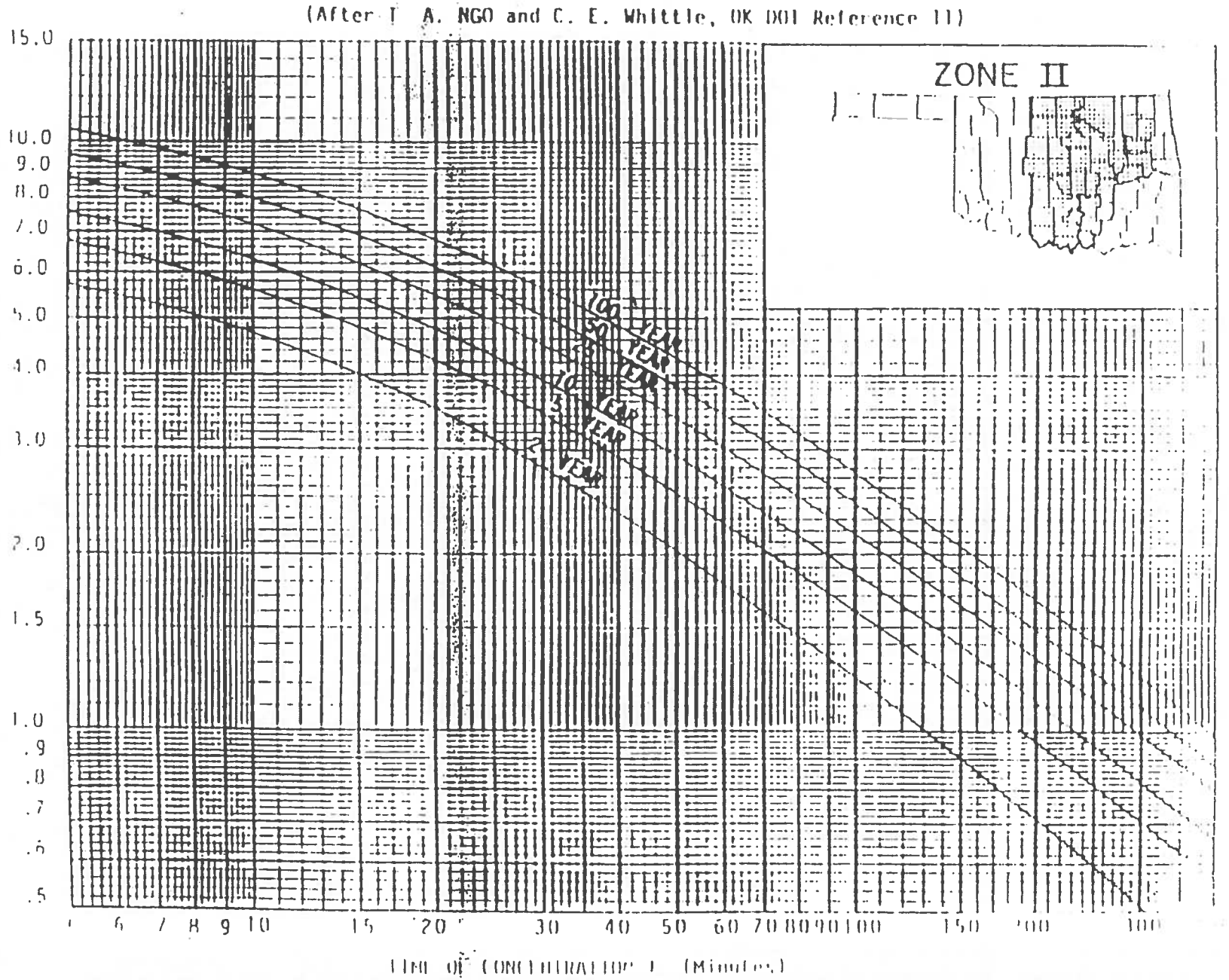
The size and shape of the watershed must be determined. Drainage areas shall be determined through the use of planimetric topographic maps, supplemented by field surveys. A drainage area map shall be provided for each project. The drainage area contributing to the system being designed and drainage sub-area contributing to each inlet point shall be identified. The outlines of the drainage divides must follow actual lines rather than artificial land divisions.

REVISED JULY 2005

RATIONAL METHOD "C" VALUES

Rural Single Family	C=0.6
Single Family Residential	C=0.7
Duplex	C=0.75
Quad-plex	C=0.8
Apartments	C=0.85
Commercial – Offices	C=0.9
Shopping Center	C=0.95
Industrial	C=0.95
Undeveloped	C=0.5 (see Note 1)
Parks and School Yards	C=0.5 (see Note 1)

Note 1: The Design Engineer shall evaluate the hydrological soil group and ground slope in confirming undeveloped c value of 0.5 is appropriate for the project.


(After T. A. NGO and C. E. Whittle, OK DOT Reference 11)
ZONE II
15.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.5
1.0
.9
.8
.7
.6
.5
100 YEAR
50 YEAR
25 YEAR
10 YEAR
5 YEAR
6 7 8 9 10 15 20 30 40 50 60 70 80 90 100 150 200 300
TIME OF CONCENTRATION, T (Minutes)

SECTION III

FLOW IN STREETS

GENERAL:

The location of inlets and permissible flow of water in the streets should be related to the extent and frequency of interference to traffic and the likelihood of flood damage to surrounding property. Interference to traffic is regulated by design limits of the depth and spread of water into traffic lanes, especially in regard to collector streets and arterials.

DESIGN CRITERIA:

(A) Flow in gutters which are on straight or parabolic crown pavement may be determined by using Manning's Formula for channel flow or acceptable monographs.

(B) Minimum gutter slope on residential streets shall not be less than 0.004 ft/ft (0.4%). Maximum gutter slope should not be more than .08 ft/ft (8.0%). In a gutter which has a radius of 100' or less, the design flow depth shall not exceed 70% of the curb height.

(C) No lowering of the standard height of street crown or splitting of curb heights shall be allowed for the purpose of hydraulic design unless approved by the City Engineer. In no case will it be allowed on collector streets or thoroughfares.

(D) All street sections shall have a positive crown except alleys.

(E) The flow depth in the gutter of arterial streets shall not exceed 4" for the 50 year storm event nor 6" for the 100 year storm event. The flow depth in the gutter on other classification of streets shall not exceed 6" for the 100 year storm event. Where two (2) or more streets flowing 6" in depth intersect the flow shall be intercepted by appropriate storm sewer techniques prior to the intersection of said streets such that the depth of flow within the intersection will not exceed 4" in depth for the 100 year storm event.

The use of a cul-de-sac or dead end street as the terminal point of residential street flow shall not be allowed for drainage areas exceeding five (5) acres. A minimum of 70% of the flow in a residential street shall be removed to a storm sewer or drainage system prior to reaching the point of curvature of a cul-de-sac or the end of the street for drainage areas exceeding five (5) acres in size.

SECTION IV

ENCLOSED STORM SEWER

GENERAL:

The use of the Manning Equation or the use of appropriate charts or nomographs in the design of storm sewers will be considered acceptable. Investigations of the capacity of all existing structures on the waterway shall be made.

In addition, runoff from storms exceeding the design storm shall be anticipated by the developer and disposed of with minimum damages to surrounding property. The sewer must be accessible for maintenance.

DESIGN CRITERIA:

(A) Pipes which are a part of the storm sewer system shall have a minimum diameter of fifteen (15) inches.

(B) Enclosed storm drains will be designed for open-channel flow.

(C) Minimum Grades: The slope shall be such to maintain a minimum velocity of 2.5 fps.

(D) Acceptable Roughness coefficient "n" for storm sewers:

Materials of Construction	Design Coefficient Manning's
Box Culverts	.013
Concrete Pipe	.012
Annular Plain Corrugated Metal Pipe	.024
Helical Plain Corrugated Metal Pipe	.016
Coated Corrugated Metal Pipe	
"n" as approved by City Engineer	

(E) General rules to be observed:

1. Do not discharge a larger pipe into a smaller one.

2. At change in pipe size match top of pipe.

3. A one (1) foot free-board shall be maintained below the proposed finish grade through the storm sewer system. The submittal of energy calculations shall be required on any reach of a system which exceeds 500 linear feet; on the total system that exceeds 1500 linear feet; on a reach of a system which has an elevation change exceeding ten (10) feet.

(F) Manhole Locations:

Manholes shall be located at intervals not to exceed 350 feet for pipe sizes 42" or less. Above 42" manholes shall be located as determined by the City Engineer. Manholes shall be located at conduit junctions, changes of grade, and changes of alignment, and changes in conduit size.

(G) Pipe Connections:

The use of one material to extend a sewer constructed of a different material shall not be allowed except at manholes, junction boxes or inlets.

(H) Pipe Laid on Curves:

Degree of curvature shall be as per manufacture's recommendations.

(I) All storm sewer outlets shall have erosion protection provided by headwalls, flared end sections, curtain walls, and etc.

INLET SYSTEM:

(A) Inlet design and location in street sections must be compatible with the allowable depth of water on the street section.

(B) Inlet location shall not interfere with vehicular or pedestrian traffic.

(C) Whenever possible inlets will intercept water before it reaches a pedestrian crosswalk, or street intersection.

(D) Inlets shall not be located in a curb radius. Where existing conditions exist that require an inlet in the radius, the radius shall not be less than 38 feet.

(E) Inlets shall be located to prevent water from minor streets spilling over and flooding major streets.

(F) All hoods in a sump condition shall be 8" opening with the gutter lowered to accommodate the inlet. Transition section shall be 10' each way.

(G) Where a curbed street crosses a bridge, gutter flow shall be intercepted and not allowed to flow onto the bridge.

(H) Inlets shall be installed at all low points with sufficient inlet design to ensure the ponding depth does not exceed 4" in a 50 year storm event.

All storm sewer systems at a low point shall provide for an overflow channel with a designated drainage easement.

(I) Inlet Capacities

No method of determining capacity is prescribed in this standard. Theoretical capacities using clear water in nomograph form have been published by various sources such as the ASCE & Highway Research Board. When using nomographs submit the source along with drainage calculations.

(J) Any inlet grates over which a bicyclist can ride shall be of a design considered bicycle safe.

SECTION V

OPEN DRAINAGE CHANNELS

NATURAL DRAINAGE FLOW.

The creation of swales, alteration of small channel capacity or direction, changing of ground cover and the lining of existing channels with other material, natural or man-produced, may be necessary in some parts of the system to achieve the objectives of this standard.

OPEN STORM DRAINAGE REQUIREMENTS

(A) All land adjoining open natural or improved storm drainage channels having an elevation below the 100-year flood elevation of the channel shall be dedicated drainage easement for the purpose of providing a zone of protection to all property owners.

(B) Any channel improvements shall be approved by the City Engineer prior to the commencement of any work thereon.

(C) Whenever channel improvements are carried out, sodding, backsloping, cribbing and other bank protection shall be designed and constructed to control siltation and erosion for the anticipated conditions and flow resulting from a 100 year frequency rainfall. (See Section VIII.)

(D) Any channel grading shall be such that water will not gather in pools.

(E) Drainage easements to provide working room for construction and access for channel maintenance shall be provided.

DESIGN CONSIDERATIONS

(A) Channels should be trapezoidal in shape, and on as flat a grade as possible.

(B) The use of Manning's Equation in the calculations of hydraulic characteristics of channels will be acceptable. The "N" value(s') used for channels shall be based on the individual channel characteristics. When submitting calculations, include the source.

(C) Constructed Channel Geometry: The minimum bottom width shall be 4' with side slopes of not steeper than 3.5 to 1 for sodded sections and a minimum bottom width of 3' with side slopes of not steeper than 1:1 for paved or rock-lined sections. Care must be exercised by the engineer to provide a safe design in relations to public areas.

(D) Flow Velocities in Channels: Velocities shall not exceed 4 fps for sections sodded in grass. Velocities in concrete lined or paved sections shall not exceed 15 fps. The dissipation of energy shall be required at the confluence of improved channels with natural channels through the use of dissipaters, stilling basins and etc.

(E) Trickle Channels: All channels altered or improved from the natural state will require a paved trickle channel. Sodding, or other methods of erosion control shall be required adjacent to the paved channel.

(F) Concrete Flumes: Concrete flumes in lieu of enclosed pipe shall be allowed as overflow protection for storm sewer systems, and to drain areas not exceeding five (5) acres in size. All concrete flumes shall extend to the rear of adjacent lots and shall discharge into a dedicated drainage area or channel.

SECTION VI

DEVELOPMENT GRADING

PURPOSE

The purpose of this section is to require proper planning and execution of good grading layouts to insure that the street grades, floor elevations and lot grades are in proper relation to each other and to existing topography, considering property protection, appeal and use.

DESIGN CONSIDERATIONS

(A) Non-Residential (Including multi-family). All roofs, paved areas, yards, courts and courtyards shall drain into a storm sewer system or to an approved place of disposal not generally including existing streets.

Site plans detailing the layout and design of the storm water runoff system shall be submitted prior to site plan review by the Planning Commission or City Council or the issuance of a building permit and/or work order. All design submittals shall detail the location and features of a proposed drainage system. The submittals shall include, but not be limited to, grading plans, drainage plans, utility plans and erosion control plans.

(B) Residential (One-Family or Two Family Structures)

(1) In single family residential, duplex or mobile home developments, storm water runoff from each dwelling lot may be discharged onto flat areas such as streets or lawns if drainage is provided so that the storm water will flow away from the building.

It shall remain the responsibility of the Builder/Developer of a lot to ensure proper and prudent lot grading. The Builder/Developer shall follow the grading plan established for that lot, or in the absence of such a plan the Builder/Developer shall grade the lot following the existing, natural drainage patterns for the area, in no case shall a Builder/Developer direct, redirect or change the historic patterns of the storm water runoff.

(2) Development Grading Plans

The submittal of a Master Development Grading Plan shall be required as part of Final Plan submittal. The Master Development Grading Plan shall incorporate but not be limited to the following:

(A) Determine the type (front to rear, side to rear, rear to front, etc.) of grading for each block, lot or portion of a development and indicate the grading type for each area by identifying letter or drainage arrows.

(B) Determine the necessity for easements and other provisions needed for satisfactory drainage and erosions control.

(C) Determine general grading limitations for local conditions, such as minimum gradients for grass slopes and swales.

(D) For each area, determine the necessity for specific grading limitations along a typical grading control line from street to the house and determine the minimum street-to-floor rise (if applicable).

(E) For each development, determine reference elevations for key points giving due consideration to street elevations, and existing topography.

(F) The Owner/Developer shall provide a Builder/Developer with the approved grading plan.

(3) Building Permit Applicant

(A) The Permit Applicant (Builder) shall become familiar with the various lot grading types proposed for a particular development.

(B) The Builder shall submit, along with the Building Permit Application, a detailed site plan showing the proposed grading by identifying letter or drainage arrows.

(C) Establish key elevations or other referenced markers to the grading type and anticipated storm water runoff for the development area.

(D) Prior to finish grading, establish grade stakes as necessary and check the entire lot for proper drainage according to the Master Grading Plan.

SECTION VII

STORM WATER STORAGE

GENERAL:

"The use of storm water storage basins in urbanizing areas does not guarantee that downstream runoff peak flows will remain below their pre-development levels for a given rainfall event."[1]

"Detention basins can be used in an attempt to replicate the characteristics of natural infiltration, storage, and the attenuation of flow that is lost through urbanization. The objectives are to provide a volume of storage to compensate for that lost by development of the land, and to control the detention basin discharge so that the peak flow after urbanization remains below the pre-urban peak for a given year."[1]

"Although individual detention basins can meet the design objectives, the downstream peak flow may actually increase due to the timing characteristics of the resulting runoff within the watershed. Because of this "peak timing" effect, certain areas of a watershed may be more effective than others, as basin location sites, to control downstream peaks."[1]

Thus as studies have shown on-site detention will either increase flood peaks or decrease flood peaks at any given point in a watershed, dependent upon location of a detention facility, and the physical features of the basin.

LOCATION CONSIDERATIONS FOR STORM WATER STORAGE:

(A) Design of storm water storage facilities shall include an analysis of the downstream effects on peak flows based upon the following drainage area criteria:

(1) Residential developments including duplex and mobile home developments of 20 acres and larger shall submit a model of the storm water storage outflow hydrograph.

(2) Non-residential and all other developments, not included in No. 1 above, of 10 acres and larger shall submit a model of the storm water storage outflow hydrograph.

(B) Modeling of and routing of outflow hydrographs downstream shall be required under criteria above and will be accomplished through the use of HEC 1 and HEC 2 computer programs.

(C) The length of a stream reach requiring modeling shall be either (1) to a point where no increase in peak flow is demonstrated or (2) to a point where an increase in peak flow does not increase the depth of flooding.

[1] Mark S. Sloat, Dept. of CN Engrg., California State Univ., Sacramento, California.
Ralph B. Hwang, Dept. of Civ. Engrg., California State Univ., Sacramento, California.

(D) The storm events to be modeled shall be the 2, 5, 10, 25, 50, and 100 year storm events.

(E) The City shall make available all existing data on storm water flows from sources such as Flood Insurance studies (FIS). An Engineer shall not be required to generate the files necessary for the modeling requirements listed above. However, an Engineer will be required to furnish any information or computer software necessary for him to complete a peak flow study when supplied with the flood study data files.

(F) In the event peak flow studies indicate a development can not comply with the criteria stated in "C" above then alternative methods of storm water runoff control may be required. Alternative methods may include but not be limited to; release of larger peak flows, decrease of peak flows released, release of all or some certain storm events in lieu of detention, and/or provide channel improvements in lieu of detention.

(G) The City Council shall review all storm water storage studies and shall implement the conditions of this section of these drainage standards.

DESIGN CONSIDERATIONS FOR RAINFALL AND RUNOFF STORAGE:

Retention and detention are two general terms relating to types of storm water runoff storage that can be utilized to reduce the likelihood of additional flooding due to development and the subsequent change in storm water runoff characteristics.

Storage may be accomplished by the detention or retention of water in reservoirs, parks, side channels, or ponds either on or off-site.

Storm water storage shall be required where proposed development will be changing the natural state of the drainage area and subsequent storm water runoff.

However, in the event a complete drainage study by a licensed professional engineer demonstrates that no additional protection from flooding would be provided or that an increase in downstream flooding would occur, the requirement for storm water storage may be waived by the City Council.

Possible conditions where storm water storage may not be required could be as follows:

1) The lower reaches of a drainage basin where a well defined floodplain or major water body provides potential storm water storage needs.

2) Areas where channel improvements are existing which provide the capacity and flooding protection required for basin development.

3) Areas where the confluence of two or more tributaries of a drainage channel might produce unfavorable increases in flooding depths.

4) Changes in existing timing patterns such that peak flows are cumulative and might produce increases in flooding depths downstream.

The above examples should not be considered the only cases where storm water storage might be waived nor should the above be considered only those conditions requiring review. An engineer submitting a request to waive the storm water storage requirement will be required to produce a detailed drainage study containing any information necessary for the City to make a determination. No limits of the extent of a study should be assumed by an engineer as none are provided.

The terms, detention, retention and sedimentation basin shall have the meanings used below:

(A) DETENTION FACILITY - A surface water runoff storage facility that is normally dry but is designed to hold (detain) surface water temporarily during and immediately after a runoff event. The detention facility can be either surface level or underground. Public safety and maintenance shall be paramount in both the surface level and underground facilities.

(B) RETENTION FACILITY - A surface water runoff storage facility that always contains (retains) a substantial volume of water to serve recreational, aesthetic, water supply, or other function. Surface water runoff is temporarily stored above the normal stage during and immediately after runoff events.

(C) SEDIMENTATION BASIN - a surface water runoff storage facility intended to trap suspended solids, suspended and buoyant debris, and absorbed or absorbed potential pollutants which are carried by surface water runoff. The basin may be part of an overall multipurpose storm water drainage system.

(D) The sizing of storage facilities shall be by an approved method such as APWA Unit Hydrograph, SCS, HEC 1, and etc. All storm water storage facilities serving drainage areas 4 acres and larger shall be analyzed by routing an inflow hydrograph through the storage outlet structure(s). All data, calculations and assumptions shall be provided in report form.

(E) The detention facility shall be designed based upon the maximum allowable release rates. The release rates will be established based upon natural state runoff characteristics from the development site. A continuous probability or recurrence interval criterion shall be used in designing the outlet control structure. As a minimum the outlet control structure shall be designed for the 2, 5, 10, 25, 50 and 100 year recurrence intervals. A single stage outlet control structure will not be considered acceptable.

(F) Rooftop storage, if used, shall be designed into the original building plans and not added to existing structures as an afterthought due to possible structural failure as well as water damage to the building contents through leakage. Such plans shall bear the seal of a registered architect or engineer. The roof should drain within twelve (12) hours. Temporary roof dams of loose gravel shall not be allowed.

(G) When a combination of storage facilities are used to control runoff, the system as a whole shall be designed with discharge rates in accordance with B above.

(H) All facilities shall be provided with an emergency spillway with scour protection. Earth embankments shall have side slopes not steeper than 4:1. Proper materials shall be specified with the corresponding optimum compaction to provide stability and minimum seepage.

(I) The storage volume of a storage facility shall be oversized 10% to allow for sedimentation.

(J) All storage ponds shall be provided with a concrete paved trickle channel from the inlet to the outlet structure to transmit low flows unless the flow line of the storage facility is entirely on rock.

(K) Erosion control for storage and/or detention facilities shall be in accordance with Section VIII Erosion and Sedimentation.

(L) A paved access road shall be provided to all storage areas for maintenance purposes. For those owned and maintained by the City the access road shall be dedicated as part of the storage area.

(M) Earth dams or other earth embankments shall be designed by a licensed professional engineer in accordance with accepted engineering practices to assure that dam or embankment failure will not occur. Design criteria used by the Soil Conservation Service in the selection of materials and construction procedures will be acceptable.

(N) Property line swale ponding and small on-site ponds, if used, shall be examined for possible adverse effects on building foundations due to saturation of the subsoil.

(O) Parking lot storage shall be considered the last alternative of providing required detention. The use of parking lots for storage shall be well designed to minimize the potential damage and/or threat to pedestrians and parked vehicles. In no case shall the depth of ponding in a parking lot exceed six inches (6").

(P) Public safety of the drainage facilities and outlet works, both in a passive condition and when functioning shall be addressed in design.

(Q) The detention facility shall be designed as a visual amenity consistent with the existing topography and proposed development and should be designed with multi-use potentials related to recreation taken into consideration.

The use of large unnatural depressions which disrupt the continuity of the landscape shall be avoided. Length to width ratios should be investigated in relation to depth of the proposed facility to improve the aesthetic appearance of storage facilities. The geometric layout of detention facilities shall be such that multi-purpose use is available.

All storage facilities shall be provided and maintained with landscaping which includes the planting of trees and shrubs. The use of evergreen and wetlands adaptable plantings should be incorporated to improve the water quality of the storage runoff.

Outlet control facilities shall include headwalls and energy dissipaters. The outlet facilities, as a visible part of any storage facility, shall include landscape plantings to improve aesthetics and provide a more pleasant and appealing appearance.

Detention facilities which are planned for dedication to the City shall be reviewed by the Parks and Recreation Department for proper recreational layout and design. Landscaping of all facilities including access roads and parking areas (storage facilities 3 acres and larger) shall be of sufficient size and number to provide a park like setting.

SECTION VIII

EROSION AND SEDIMENTATION CONTROL

PURPOSE

The purpose of this section is to provide guidance in the design of effective management of erosion and sedimentation and to protect water quality and the general health, safety and welfare of the residents of the City of Yukon.

GENERAL REQUIREMENTS

(A) Development activity shall not be conducted unless appropriate erosion and sedimentation facilities are designed, installed and maintained throughout the life of the development.

(B) All erosion and sediment control methods shall be indicated on the final construction and/or building permit plans.

(C) All earth slopes and earth areas, new or existing, subject to erosion, such as, adjacent to trickle channels, inlet structures, and outlet structures, within any area designated for detention or drainage shall be slab sodded with Bermuda sod or have permanent established growth of vegetation. All vegetation areas shall be fertilized, watered, and in an established growing condition prior to completion or acceptance of any storm water drainage facility, and/or development.

DESIGN CONSIDERATIONS

(A) General Design Principals. Practical combinations of the following principles shall be utilized, as a minimum, in planning measures to be installed for any land disturbing activity.

(1) The land disturbing activity shall conform to existing topography and soil type so as to create the lowest practicable erosion potential.

(2) The disturbed area and the duration of exposure of bare earth to erosive elements shall be kept to a practicable minimum through construction scheduling and management.

(3) Cut and fill operations should be kept to a minimum.

(4) Disturbed soil shall be stabilized as quickly as practicable.

(5) Natural vegetation shall be retained, protected, and supplemented whenever feasible.

(6) Temporary vegetation or mulching shall be employed to protect exposed critical areas during development.

(7) Permanent vegetation and structural erosion control measures shall be installed prior to final acceptance of developments, or as soon as seasonal planting restrictions allow.

(B) General Practice: Soil and water conservation measures include but are not necessarily restricted to vegetation, sediment basins, dikes, grade stabilization structures, sediment traps, land grading, diversions, waterways or outlets, and rip-rap.

Vegetative practices shall be applied to control erosion. The practice can be either temporary and/or permanent depending on the site specific needs.

EROSION AND SEDIMENT CONTROL CRITERIA

(A) Long term permanent seeding, sprigging, or planting which produces vegetative cover including Bermuda grass, Kentucky 31 Tall Fescue and Weeping Love Grass shall be used to control erosion on a permanent basis.

(B) Short term seeding, producing temporary vegetative cover such as small grains like oats, rye and wheat, and sudans and sorghums shall be used to control immediate erosion. This practice effective for areas where soil is left exposed for a period of 6 to 12 months shall not be deemed permanent erosion control.

Straw Bale Dike may be utilized where no other practice is feasible, a temporary barrier with a life expectancy of three months or less can be installed across or at the toe of a slope for the contributing drainage areas, in accordance with the adopted standards.

Hay and sod mulching, as a temporary measure, may be used for embankment stabilization in areas where surface runoff is to be directed down a slope.

Erosion matting shall be used for channel embankment and slope stabilization where a permanent erosion control cover has not been established prior to use. The specified material shall be installed as recommended by the manufacturer of the proposed material.

(C) A stabilized construction entrance shall be built in accordance with the adopted standards to reduce or eliminate the tracking or flowing of sediment onto public right-of-way.

(D) A concrete or stone outlet structure shall be constructed in areas where the entire drainage area to the structure is not stabilized or where there is a need to dispose runoff at a protected outlet or where concentrated flow for the duration of the period of construction needs to be diffused.

(E) A grade stabilization structure in the form of a paved chute or flume shall be constructed to prevent erosion, where concentrated flow of surface runoff is to be conveyed down a slope of 3% or greater.

(F) Storm water detention facilities may be used temporarily as sediment basins. A temporary outlet structure for the store water detention facility to work as a sediment pond shall be constructed. At the end of the construction activity, the developer shall remove all collected sediment from the detention facility and outlet structure and return the facility to a previous condition and/or to the approved cross-sectional area.