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Alternate B- Detention Concept

PRELIMINARY TECHNICAL INFORMATION REPORT And DOWNSTREAM ANALYSIS for

TALL CHIEF COUNTRY CLUB RESIDENTIAL PLAT PROJECT

Location:
1313 W. SNOQUALMIE RIVER ROAD
FALL CITY, WA 98024

September 1, 2009
Revised 12/31/10
Revised 2/17/11

By

Hagenson Consultants, LLC
Seattle, Washington 98136

HC Job No. 200422

K.C Project # L04P0032

L12V0002

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STATE OF WASHINGTON
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2/17/11

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- Geotechnical Report – Under separate cover
- ROAD VARIANCE APPROVAL
- DRAINAGE VARIANCE APPLICATION

B. CORE AND SPECIAL REQUIREMENTS ANALYSIS

This section of the TIR is intended to meet agency specific requirements for a report addressing all Core and Special Requirements of the 1998 King County Surface Water Manual.

Core Requirement 1. Discharge at the Natural Location

The southern site drainage lies in the Patterson Creek Basin. Drainage from the hillside is currently largely un concentrated as it runs through the forested hillside. At the upper back 9-hole golf course elevation, drainage is conveyed downstream from that point in gullies to the slough at the valley floor. Drainage patterns will be maintained for Lots 8 thru 12 in the Patterson Creek Basin by using roof and driveway dispersal systems. However, a SWM Drainage Adjustment is sought to allow diversion of a 21.0-acre portion of the Patterson Creek Basin to be detained and then discharged to the Snoqualmie River Basin (see Basin Map). The conveyance system would collect drainage from the Tall Chief and Aldera Ridge Roads, as well as areas upstream thereof, and direct them to the proposed detention system for the Snoqualmie basin portion of the project (as discussed below).

The northern site drainage lies in the Snoqualmie River Basin. Drainage from the hillside is also largely unconcentrated as it runs through the forested hillside. Several shallow grassy swales intercept hillside runoff and direct it towards the steep slope banks on the central easterly perimeter of the project. At the lower front 9-hole golf course elevation (i.e. the north portion of the project), drainage is intercepted into a series of channels and wetland ponds lying at the base of the hillside. Drainage from this channel is conveyed northerly to its natural discharge point near the northeast portion of the project boundary and eventually towards the offsite "Green" slough and the Snoqualmie River. Drainage patterns for the Snoqualmie River Basin portion of the project will be maintained to their current condition by means of a proposed flow control manhole or weir outlet at the proposed wet/detention pond, which will send pond discharges toward the on-site central swale that leads to the Green Slough.

Of note, 2006 draft FEMA FIRM updates indicate the Snoqualmie River and Patterson Creek 100 year floodplains are concurrent at a point upstream from where the project drainage discharges from the site. In some terms, this may be interpreted as indicating that the Patterson Creek sub-basins and the Snoqualmie sub-basins are inseparable at this point, further providing justification for the basin diversion.

The proposed draft FIRM also indicates a revision to the project flood plain elevations, down from 185 in the current versions to elevation 184 to 182 in the draft version.

Core Requirement 2. Offsite Analysis

A level one-offsite analysis is required and is provided in the appendix of the Technical Information Report (TIR).

Core Requirement 3: Flow Control

The site lies in a level two flow control area. Although the entire site qualifies for exemptions as detailed below, specific recommendations in the Geotechnical Engineering Report require that drainage on the hillside be collected in tightlines where possible and conveyed to a discharge point near the valley floor to avoid hillside erosion and instability.

Both the Snoqualmie Basin portion and the Patterson Creek Basin portion qualify for the Forested Open Space exemption number 5. Both these portions of the project are a rural residential project in the RA-5 and RA-10 Zone. 65% of the un-submerged drainage area will be dedicated in easements or tracts as Forested Open Space. BMP's such as roof and driveway dispersal will be used to accommodate drainage requirements on each of the proposed lots that cannot stub directly into the roadway storm drains.

Roof drain dispersal will largely rely on the splash block method, with 50' min. vegetated flow paths between the roof and any structure or property line. Road dispersal for the driveways will rely partially on sheet flow and where concentrated flows result from roadway cut ends or uphill ditch systems, direct discharges to rock pads with 100 foot flow paths thru vegetation will be allowed where 100 year flows are less than 0.2cfs. Dispersion trenches will be used otherwise, such that any 50' dispersion trench receives no more than 0.5 cfs in the 100-year event. In compliance with the geotechnical report recommendations, emphasis is placed on collecting runoff from the hillside bench area and discharging it to the valley floor (through the wet/detention pond) in an effort to avoid hillside erosion and instability. To facilitate collection, a French drain is proposed at approximate elevation 330 along lots 13 thru 16. Extensive sub-basin delineation and modeling will be provided at the construction document phase.

Approximately 21.0 acres of the Patterson Creek Basin will be diverted northwards along proposed Tall Chief Road and ultimately discharged to the Onsite wet/detention pond along with those portions of the project that lie in the Snoqualmie River Basin. A SWM Drainage Adjustment application is made for this purpose. Since there is no feasible opportunity to drain the Patterson Creek Hillside drainage to the valley floor within the Patterson Creek Basin, the diversion will further allow the removal of drainage from the hillside to avoid erosion and instability. It is assumed that a geohydrologic report may be required to show that there are no surficial or interflow aquifers present which might otherwise affect the Patterson Creek base flows. However, given that the Patterson sub basin is the lowest portion of the basin prior to confluence with the Snoqualmie River, we have assumed this conclusion is highly likely.

The proposed wet/detention pond lying in Tracts Q and P will serve both the Patterson Creek and Snoqualmie Creek Basin portions of the project where they are of sufficient elevation to connect to the Tall Chief Road Storm Drainage Trunk line. Detention modeling calculations include proposed developed lot credits for 65% open space, and assume 20% maximum impervious area per lot and 15% developed pervious area per lot in compliance with established zoning code limits, with credits for roof downspout and driveway dispersion wherein the impervious area is modeled as 50% impervious and 50% pervious in compliance with the 98 KCSWDM.

Stormwater Flow Control is required for existing portions of Tall Chief Road which will be slightly widened (approx station 0+00 to 17+75) and for frontage portions of Snoqualmie River Road which will be slightly widened with a 4 foot shoulder. These areas lie below the elevation of the proposed wet/detention pond and are therefore bypass areas. Flow Control will be achieved by compensating for these bypass areas.

See Section IV of the TIR for details.

Core Requirement 4: Conveyance System

A conveyance analysis will be provided in Section V of the TIR for the construction document phase. The conveyance system will meet all applicable codes. Preliminary calculations are included herewith to justify the approximate size of the conveyance piping.

Core Requirement 5: Erosion and Sedimentation Control

Erosion Control Systems are required. Patterson Creek portions of the site are in a P suffix Zone and pertinent conditions apply per KCC 16.82.150D, specifically limiting construction to the March 31 thru Oct 1 period and limiting clearing to 60% of the site. *Specific ESC systems will be recommended in Section IX of the TIR and a separate ESC plan will be prepared for the Construction Document Phase. The ESC plan shall meet all applicable codes.*

Core Requirement 7: Financial Guarantees and Liability

Per paragraph 1 of KCSWM 1.2.7, financial guarantees will be required. A Bond Quantity worksheet will be provided for public and private improvements after first county review.

Core Requirement 8: Water Quality

The site lies in a Basic Water Quality area. Although the entire site qualifies for exemptions as detailed below, specific recommendations in the Geotechnical Engineering Report require that drainage on the hillside be collected in tightlines where possible and conveyed to a discharge point near the valley floor to avoid hillside erosion and instability. Consequently, collected stormwater containing runoff from pollution generating impervious surfaces such as roadways, must be treated.

For both the Snoqualmie Basin Portion and the Patterson Creek portion of the project, exemption number 3, Forested Open Space for Rural Residential Projects will apply (KCSWM pg. 1-50 to 1-51). Exemption #3 indicates that any proposed natural discharge area within a project is exempt provided:

1. At least 65% of the unsubmerged portion of the natural discharge area is set aside as forested open space as specified in Section 5.2.1 and
2. The runoff from roads and driveways is dispersed through at least 100 feet of native vegetation (per 5.2.1) and
3. The runoff from continuous lawn areas of 1 acre or more is dispersed through at least 25 feet of native vegetation onsite per 1.2.8.2 (P-1-57).

Per KCSM manual, PG 5-15, appendix C and Section 4.2.2, runoff dispersal can be used as an alternative method to accomplish water quality requirements, such that filtration through grass/pasture removes harmful pollutants. This approach will be applied to those portions of the project that are not treated by grass filtration or otherwise collected and conveyed to the wet/detention pond.

Water Quality facilities will consist of a wet/detention pond in Tract Q of the lower 9 hole portion (i.e. northerly portion) of the project. A portion of this facility lies within the 100-year floodplain. Consequently, a compensating volume will be excavated from the hillside area near Tract A to create mitigation floodplain storage.

Water Quality treatment are required for existing portions of Tall Chief Road which will be slightly widened (approx station 0+00 to 17+75) and for frontage portions of Snoqualmie River Road which will be slightly widened. These areas are below the elevation of the proposed wet pond. Treatment will be achieved by providing 20 foot basic grass filter strips along the length of the roadway per KCSWM pg. 6.56, Section 6.3.4. Some of this portion of Tall Chief Road (sta 13+50 to 17+75) cannot accommodate a filter strip due to the adjacent wetland proximity. This area will be treated with a storm filter media/compost filter system.

As noted above, roof downspout dispersal will be utilized for all buildings, as required. *Design details will be provided in section IV of the TIR for the Construction Document phase of the project.*

Special Requirement #1: Other adopted area-specific requirements.

Portions of the site are located in the Patterson Creek Drainage Basin. The site is shown as a level 2 flow control area and a Basic Water Quality treatment area. The Zoning designation lists P suffix conditions (see section IV for additional details).

Special Requirement #2: Floodplain/Floodway delineation

The project does contain a wetland and portions are within the 100-year floodplain. The floodplain has been established through the FEMA Flood Insurance Rate Map, and will be recorded on final construction documents. Preliminary floodplain locations are shown on the attached excerpts from the King County Imap web site and current FEMA FIRM (Flood Insurance Rate Map).

Special Requirement #3: Flood Protection Facilities

The project involves no new flood protection facilities nor modifications to any existing ones. Therefore, this requirement does not apply to the site.

Special Requirement #4: Source Controls

The site is not a commercial, industrial nor multifamily project. Therefore, this requirement does not apply to the site.

I. PROJECT OVERVIEW

The Proposed Development includes platting 18 residential lots on the existing 191.2 acres, consisting of 4 separate tax parcels. Clustering will be used such that the northerly 9 holes of the existing 18-hole country club golf course will be reverted to agrarian or conservancy uses. Construction of a new Rural Minor access road (Tall Chief Road and Aldera Ridge Road) will provide the necessary access. Emergency Access will be provided via Campground Road. Existing Zoning is predominantly RA-10 with some RA-5-P. The site is located at 1313 West Snoqualmie River Road in un-incorporated King County, near Fall City, WA. Grading, utility and drainage improvements will be prepared in compliance with the current County Code based on the 1998 surface water manual.

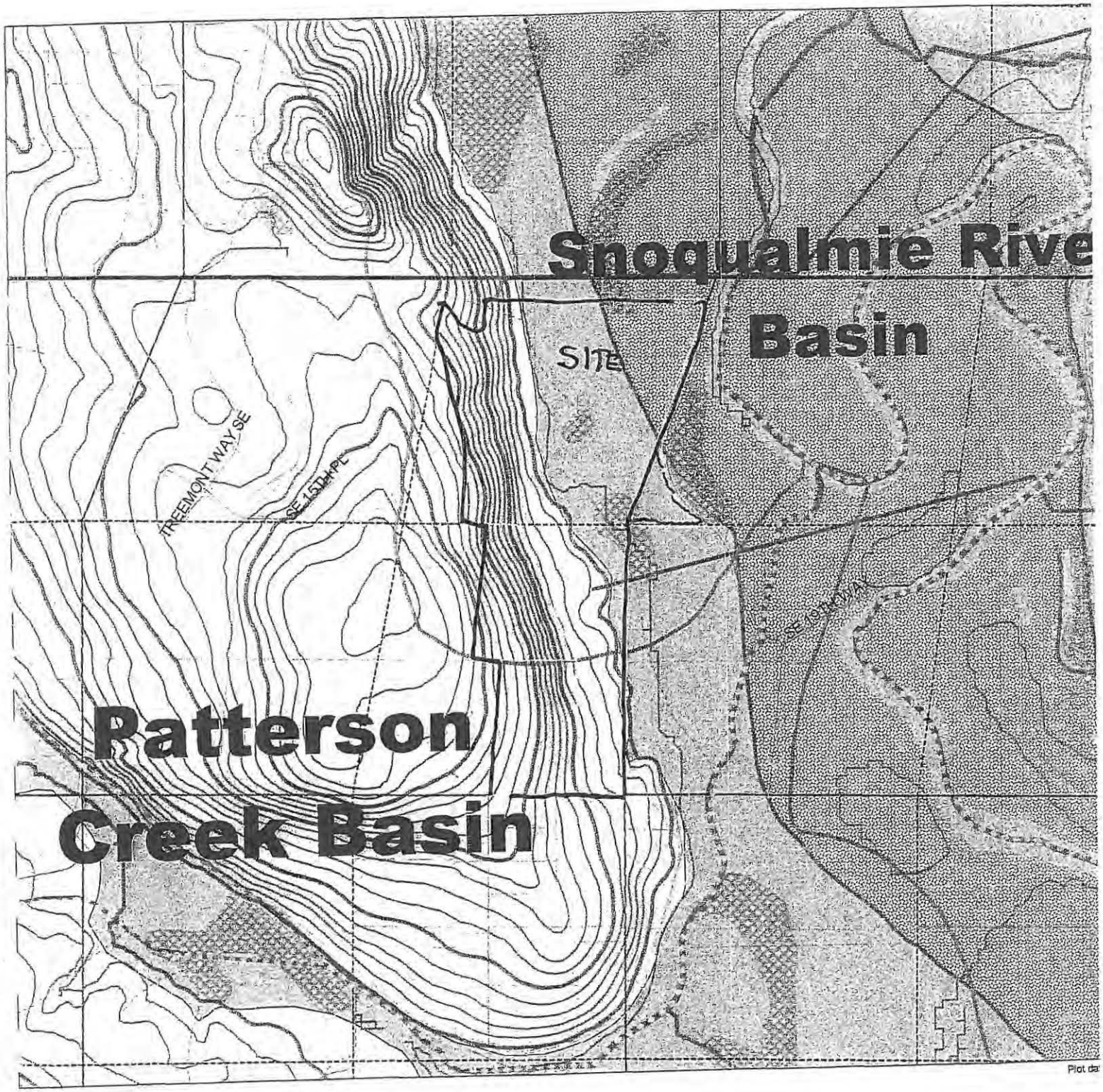
The northerly ¾ of the site lies in the Snoqualmie River Basin, while the remainder lies in the Patterson Creek Basin. Grading, utility and drainage improvements will be prepared in compliance with the current County Code.

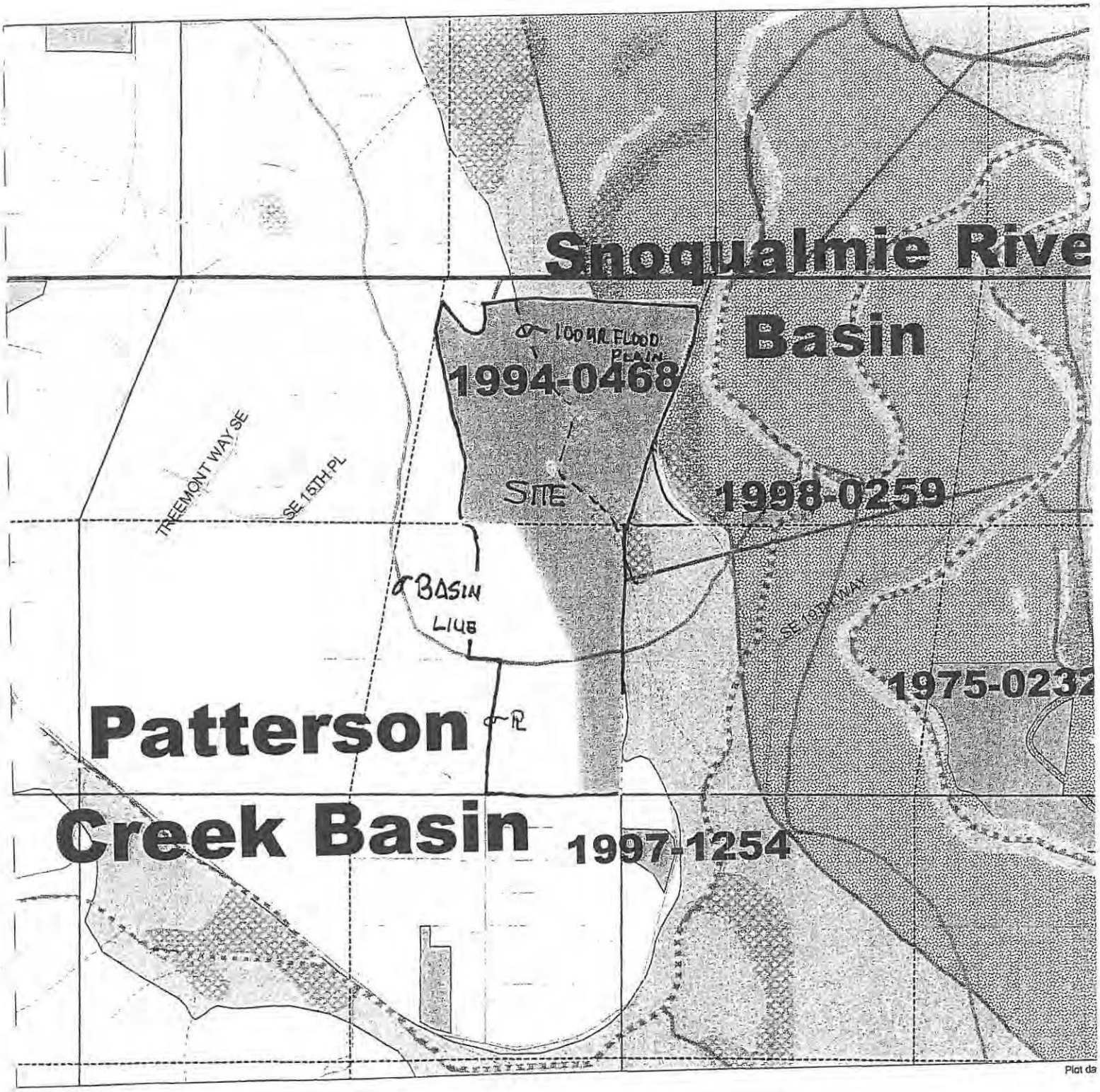
One other very important feature in the project is the density (0.09 lots/ac or 10.6 ac/lot). With the limitation on clearing, the proponent would be clearing a maximum of 39.14 acres or 20% of the 191.2 acre site (assuming 65% open space on Patterson Basin lots and 80% max clearing on remaining lots per RA-5 zoning code).

II. PRELIMINARY CONDITIONS SUMMARY

The property was, until recently, developed with an existing 18 whole Country Club Private Golf Course. Currently, the lower 9 hole Golf Course is still in place, but the upper 9 holes have been unused since around 2005. Forest covers the undeveloped hillside and a number of wetlands are located in the lower lying areas. Existing grades vary between very flat in the NE to beyond 40% along the hillside area. Soils are predominantly Nooksak silt loams in the valley floor and Alderwood series gravelly, sandy loams on the hillside. Both soils are till series soils. There is a small area of mixed alluvial soils identified in SCS mapping (included herein). The preliminary geotechnical report identifies thick lenses of gravelly sandy soils located in benches near the southwest portion of the project.

Site access is provided via a private road and easement adjoining West Snoqualmie River Road, which is classified as a Collector Arterial and currently improved to a rural shoulder and ditch section. Further road improvements are required to widen the existing access.


Snoqualmie Rive
Basin
SITE
TREEMONT WAY SE
SE 15TH PL
SE 10TH WAY
Patterson
Creek Basin
Plot da


Snoqualmie Rive
Basin
100 YR FLOOD PLAIN
1994-0468
SITE
1998-0259
TREEMONT WAY SE
SE 15TH PL
BASIN LINE
SE 19TH WAY
1975-0232
Patterson
Creek Basin
1997-1254

Plot da

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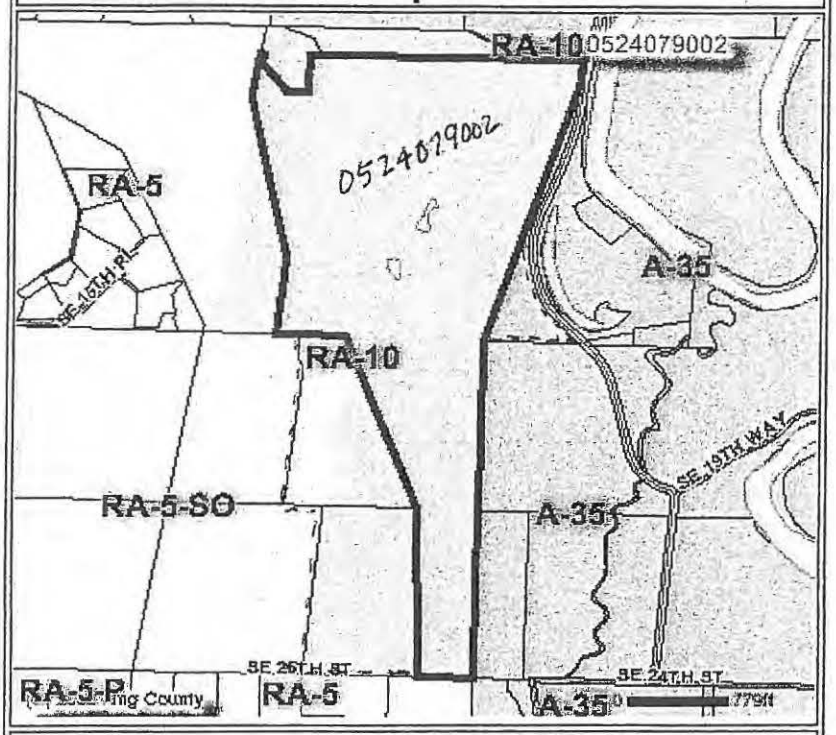
Parcel Map and Data



Parcel Number	0524079002
Address	1313 WEST SNOQUALMIE RIVER RD SE
Zipcode	98024
Taxpayer	TALL CHIEF GOLF INC

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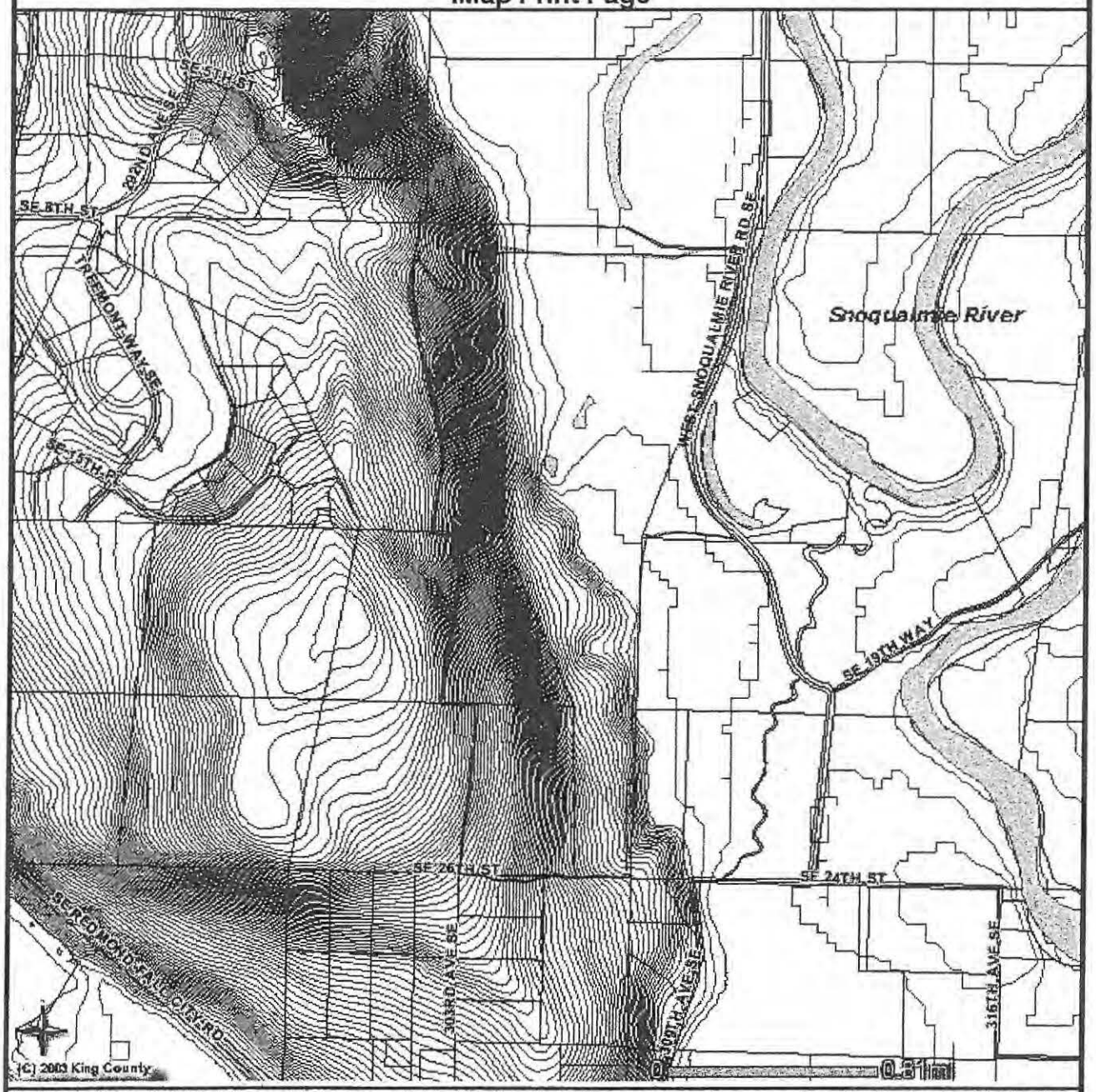

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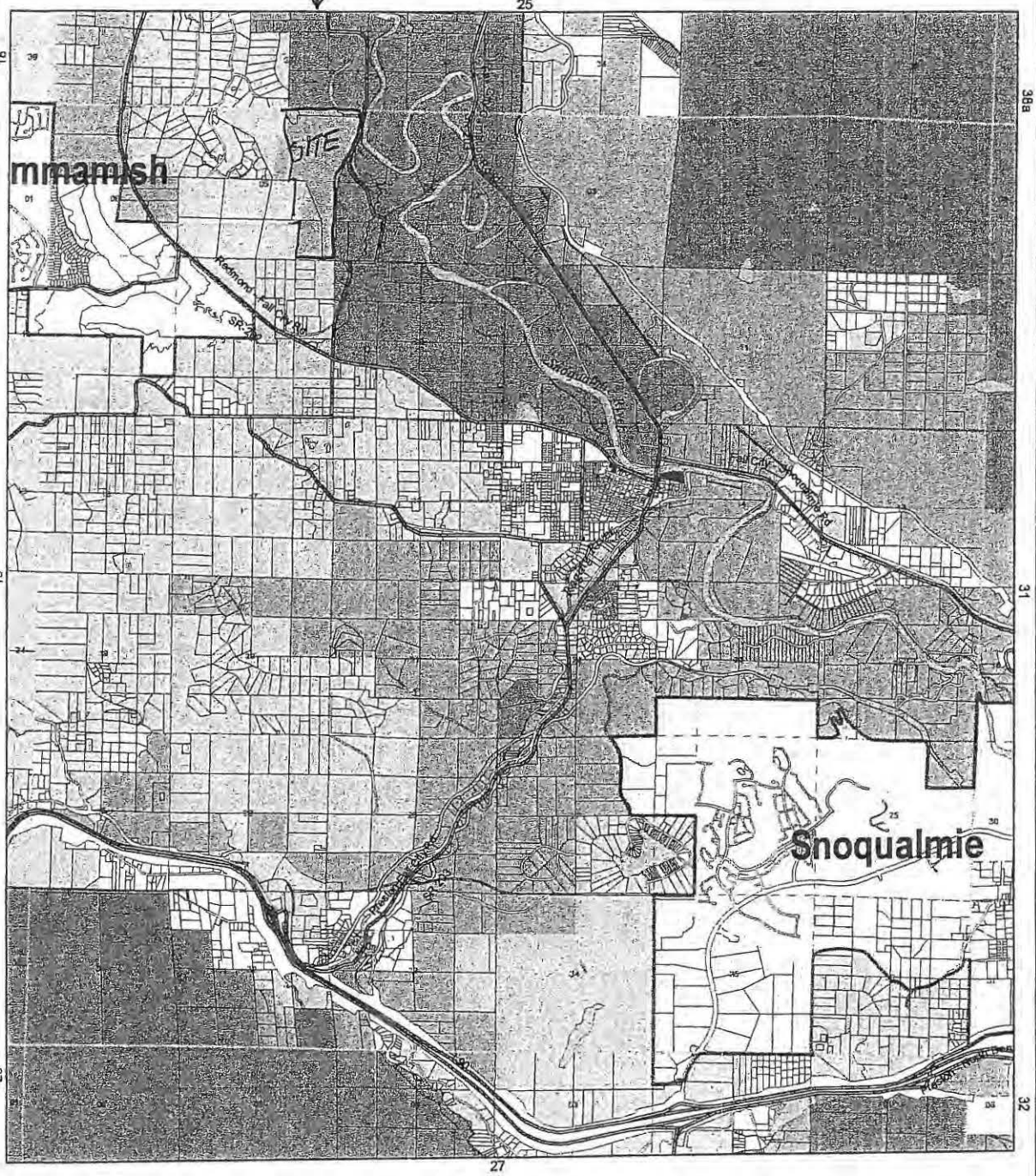

KING COUNTY ZONING ATLAS

Townships 24 Range 7

Includes zoning changes through Ordinance #14448 (August 2002)

- A-10 - Agricultural, one DU* per 10 acres
- A-35 - Agricultural, one DU* per 35 acres
- F - Forest
- M - Mineral
- RA-2.5 - Rural Area, one DU* per 5 acres
- RA-5 - Rural Area, one DU* per 5 acres
- RA-10 - Rural Area, one DU* per 10 acres
- UR - Urban Reserve, one DU* per 5 acres
- R-1 - Residential, one DU* per acre
- R-4 - Residential, 4 DU* per acre
- R-6 - Residential, 6 DU* per acre
- R-8 - Residential, 8 DU* per acre
- R-12 - Residential, 12 DU* per acre
- R-18 - Residential, 18 DU* per acre
- R-24 - Residential, 24 DU* per acre
- R-48 - Residential, 48 DU* per acre
- NB - Neighborhood Business
- CB - Community Business
- RB - Regional Business
- O - Office
- I - Industrial
- Incorporated City
- Urban Growth Area Boundary

This map shows only the base zoning for each parcel of property.

This map does not show special development conditions, such as P-suffix Conditions, Special District Overlays, or potential zoning that apply to many properties in King County.

This map is a general color representation of official zoning controls. Final decisions on any inconsistencies are based on the ordinance establishing the current zoning.

All property-specific development conditions are displayed on the official zoning control at the Department of Development and Environmental Services (DDES), 900 Oakesdale Ave SW, Renton, WA 98055, Telephone (206) 296-6600.

The atlas is produced by King County's Geographic Information System. Copies of this atlas are available for review or purchase at DDES. The atlas can be viewed on the internet at: http://www.metrokc.gov/ddes/gis/zonenotes.htm

DU* = Dwelling Unit

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N

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King County

Map generated: Feb 6, 2003

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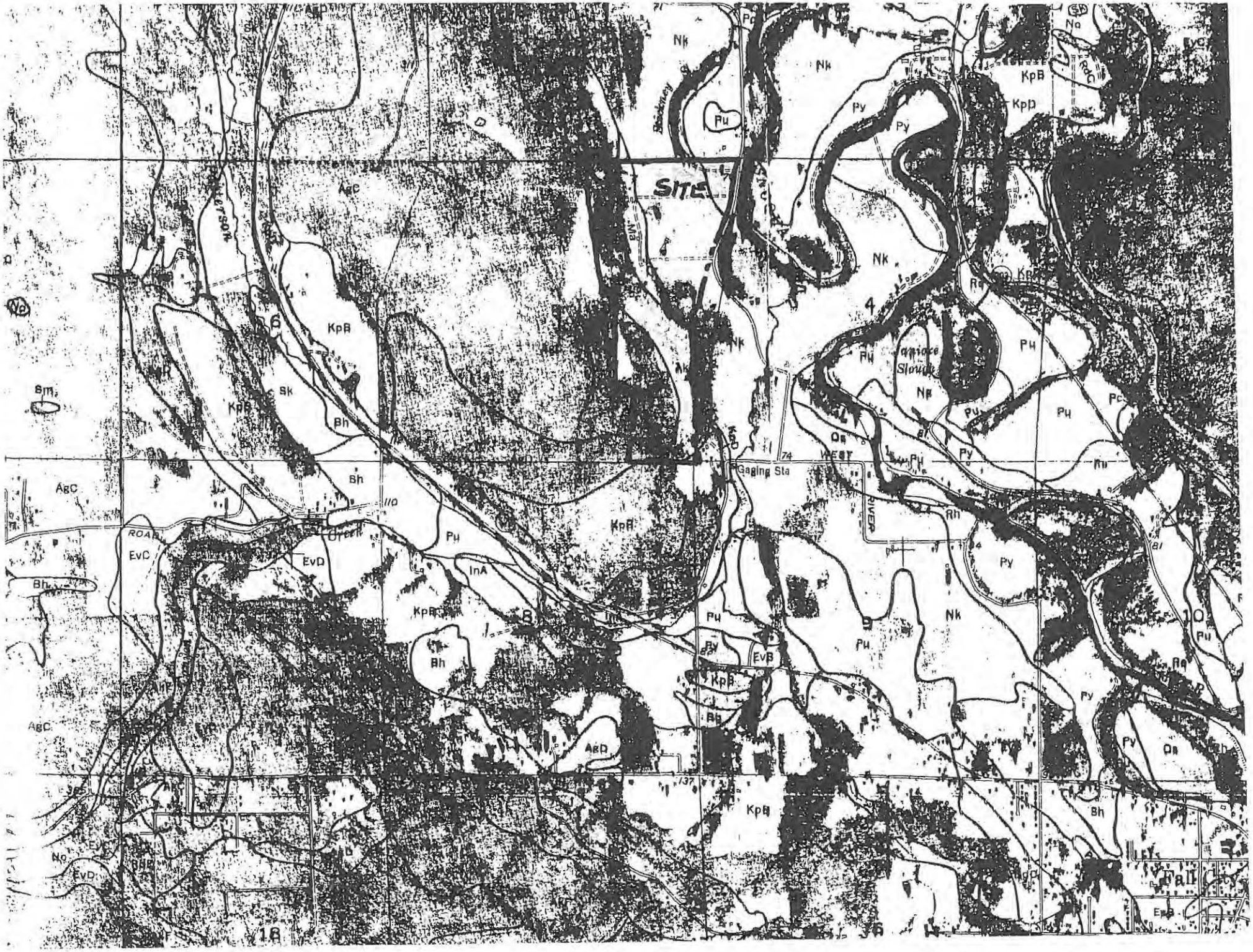
SITE
Gaging Sta
Apiece Slough
ROAD
Green
Nk
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EvC
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InA
Rh
Qa
Bm
No
Ma
Peterson
River
West
Fall
4
5
8
9
10
18
74
137

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, indicates the class of slope. Symbols without a slope letter are those of nearly level soils.

SYMBOL	NAME
AgB	Alderwood gravelly sandy loam, 0 to 6 percent slopes
AgC	Alderwood gravelly sandy loam, 6 to 15 percent slopes
AgD	Alderwood gravelly sandy loam, 15 to 30 percent slopes
AkF	Alderwood and Kitsap soils, very steep
AmB	Arents, Alderwood material, 0 to 6 percent slopes *
AmC	Arents, Alderwood material, 6 to 15 percent slopes *
An	Arents, Everett material *
BeC	Beausite gravelly sandy loam, 6 to 15 percent slopes
BeD	Beausite gravelly sandy loam, 15 to 30 percent slopes
BeF	Beausite gravelly sandy loam, 40 to 75 percent slopes
Bh	Bellingham silt loam
Br	Briscot silt loam
Bu	Buckley silt loam
Cb	Coastal Beaches
Ea	Earlmont silt loam
Ed	Edgewick fine sandy loam
EvB	Everett gravelly sandy loam, 0 to 5 percent slopes
EvC	Everett gravelly sandy loam, 5 to 15 percent slopes
EvD	Everett gravelly sandy loam, 15 to 30 percent slopes
EwC	Everett-Alderwood gravelly sandy loams, 6 to 15 percent slopes
InA	Indianola loamy fine sand, 0 to 4 percent slopes
InC	Indianola loamy fine sand, 4 to 15 percent slopes
InD	Indianola loamy fine sand, 15 to 30 percent slopes
KpB	Kitsap silt loam, 2 to 8 percent slopes
KpC	Kitsap silt loam, 8 to 15 percent slopes
KpD	Kitsap silt loam, 15 to 30 percent slopes
KsC	Klaus gravelly loamy sand, 6 to 15 percent slopes
Ma	Mixed alluvial land
NeC	Neilton very gravelly loamy sand, 2 to 15 percent slopes
Ng	Newberg silt loam
Nk	Nooksack silt loam
No	Norma sandy loam
Or	Orcas peat
Os	Oridia silt loam
OvC	Ovall gravelly loam, 0 to 15 percent slopes
OvD	Ovall gravelly loam, 15 to 25 percent slopes
OvF	Ovall gravelly loam, 40 to 75 percent slopes
Pc	Pilchuck loamy fine sand
Pk	Pilchuck fine sandy loam
Pu	Puget silty clay loam
Py	Puyallup fine sandy loam
RaC	Ragnar fine sandy loam, 6 to 15 percent slopes
RaD	Ragnar fine sandy loam, 15 to 25 percent slopes
RdC	Ragnar-Indianola association, sloping *
RdE	Ragnar-Indianola association, moderately steep *
Re	Renton silt loam
Rh	Riverwash
Sa	Salal silt loam
Sh	Sammamish silt loam
Sk	Seattle muck
Sm	Shalcar muck
Sn	Si silt loam
So	Snohomish silt loam
Sr	Snohomish silt loam, thick surface variant
Su	Sultan silt loam
Tu	Tukwila muck
Ur	Urban land
Wo	Woodinville silt loam

TABLE 3.2.2.B EQUIVALENCE BETWEEN SCS SOIL TYPES AND KCRTS SOIL TYPES

SCS Soil Type	SCS Hydrologic Soil Group	KCRTS Soil Group	Notes
Alderwood (AgB, AgC, AgD)	C	Till	
Arents, Alderwood Material (AmB, AmC)	C	Till	
Arents, Everett Material (An)	B	Outwash	1
Beausite (BeC, BeD, BeF)	C	Till	2
Bellingham (Bh)	D	Till	3
Briscot (Br)	D	Till	3
Buckley (Bu)	D	Till	4
Earlmont (Ea)	D	Till	3
Edgewick (Ed)	C	Till	3
Everett (EvB, EvC, EvD, EwC)	A/B	Outwash	1
Indianola (InC, InA, InD)	A	Outwash	1
Kitsap (KpB, KpC, KpD)	C	Till	
Klaus (KsC)	C	Outwash	1
Neilton (NeC)	A	Outwash	1
Newberg (Ng)	B	Till	3
Nooksack (Nk)	C	Till	3
Norma (No)	D	Till	3
Orcas (Or)	D	Wetland	
Oridia (Os)	D	Till	3
Ovall (OvC, OvD, OvF)	C	Till	2
Pilchuck (Pc)	C	Till	3
Puget (Pu)	D	Till	3
Puyallup (Py)	B	Till	3
Ragnar (RaC, RaD, RaC, RaE)	B	Outwash	1
Renton (Re)	D	Till	3
Salal (Sa)	C	Till	3
Sammamish (Sh)	D	Till	3
Seattle (Sk)	D	Wetland	
Shalcar (Sm)	D	Till	3
Si (Sn)	C	Till	3
Snohomish (So, Sr)	D	Till	3
Sultan (Su)	C	Till	3
Tukwila (Tu)	D	Till	3
Woodinville (Wo)	D	Till	3

Notes:

1. Where outwash soils are saturated or underlain at shallow depth (<5 feet) by glacial till, they should be treated as till soils.
2. These are bedrock soils, but calibration of HSPF by King County DNR shows bedrock soils to have similar hydrologic response to till soils.
3. These are alluvial soils, some of which are underlain by glacial till or have a seasonally high water table. In the absence of detailed study, these soils should be treated as till soils.
4. Buckley soils are formed on the low-permeability Osceola mudflow. Hydrologic response is assumed to be similar to that of till soils.

III. OFF-SITE ANALYSIS
(DOWNSTREAM DRAINAGE ANALYSIS)

See Appendix

IV. PROPOSED DRAINAGED IMPROVEMENTS

The site lies in a level two flow control area. Although the entire site qualifies for exemptions as detailed below, specific recommendations in the Geotechnical Engineering Report require that drainage on the hillside be collected in tightlines where possible and conveyed to a discharge point near the valley floor to avoid hillside erosion and instability.

Both the Snoqualmie Basin portion and the Patterson Creek Basin portion qualify for the Forested Open Space exemption number 5. Both these portions of the project are a rural residential project in the RA-5 and RA-10 Zone. 65% of the un-submerged drainage area will be dedicated in easements or tracts as Forested Open Space. BMP's such as roof and driveway dispersal will be used to accommodate drainage requirements on each of the proposed lots that cannot stub directly into the roadway storm drains.

Roof drain dispersal will largely rely on the splash block method, with 50' min. vegetated flow paths between the roof and any structure or property line. Road dispersal for the driveways will rely partially on sheet flow and where concentrated flows result from roadway cut ends or uphill ditch systems, direct discharges to rock pads with 100 foot flow paths thru vegetation will be allowed where 100 year flows are less than 0.2cfs. Dispersion trenches will be used otherwise, such that any 50' dispersion trench receives no more than 0.5 cfs in the 100-year event. In compliance with the geotechnical report recommendations, emphasis is placed on collecting runoff from the hillside bench area and discharging it to the valley floor (through the wet/detention pond) in an effort to avoid hillside erosion and instability. To facilitate collection, a French drain is proposed at approximate elevation 330 along lots 13 thru 16. Extensive sub-basin delineation and modeling will be provided at the construction document phase.

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The proposed wet/detention pond lying in Tract Q and P will serve both the Patterson Creek and Snoqualmie Creek Basin portions of the project where they are of sufficient elevation to connect to the Tall Chief Road Storm Drainage Trunk line. Detention modeling calculations include proposed developed lot credits for 65% open space, and assume 20% maximum impervious area per lot and 15% developed pervious area per lot, with credits for roof downspout and driveway dispersion wherein the impervious area is modeled as 50% impervious and 50% pervious.

Storm water Flow Control is required for existing portions of Tall Chief Road which will be slightly widened (approx station 0+00 to 17+75) and for frontage portions of Snoqualmie River Road which will be slightly widened with a 4 foot shoulder. These areas lie below the elevation of the proposed wet/detention pond and are therefore bypass areas. Flow Control will be achieved by compensating for these bypass areas (basin H) using the KCRTS model for the detention facility.

The site lies in a Basic Water Quality area. Although the entire site qualifies for exemptions as detailed below, specific recommendations in the Geotechnical Engineering Report require that drainage on the hillside be collected in tightlines where possible and conveyed to a discharge point near the valley floor to avoid hillside erosion and instability. Consequently, collected stormwater containing runoff from pollution generating impervious surfaces such as roadways, must be treated.

For both the Snoqualmie Basin Portion and the Patterson Creek portion of the project, exemption number 3, Forested Open Space for Rural Residential Projects will apply (KCSWM pg. 1-50 to 1-51). Exemption #3 indicates that any proposed natural discharge area within a project is exempt provided:

2. At least 65% of the unsubmerged portion of the natural discharge area is set aside as forested open space as specified in Section 5.2.1 and
2. The runoff from roads and driveways is dispersed through at least 100 feet of native vegetation (per 5.2.1) and
4. The runoff from continuous lawn areas of 1 acre or more is dispersed through at least 25 feet of native vegetation onsite per 1.2.8.2 (P-1-57).

Per KCSM manual, PG 5-15, appendix C and Section 4.2.2, runoff dispersal can be used as an alternative method to accomplish water quality requirements, such that filtration through grass/pasture removes harmful pollutants. This approach will be applied to those portions of the project that are not otherwise collected and conveyed to the wet/detention pond.

Water Quality facilities will consist of a wet/detention pond in Tract Q of the lower 9 hole portion (i.e. northerly portion) of the project. A portion of this facility lies within the 100-year floodplain. Consequently, a compensating volume will be excavated from the hillside area near Tract A to create mitigation floodplain storage.

Water Quality treatment are required for existing portions of Tall Chief Road which will be slightly widened (approx station 0+00 to 17+75) and for frontage portions of Snoqualmie River Road which will be slightly widened. These areas are below the elevation of the proposed wet pond. Treatment will be achieved by providing 20 foot basic grass filter strips along the length of the roadway per KCSWM pg. 6.56, Section 6.3.4. Some of this portion of Tall Chief Road (sta 13+50 to 17+75) cannot accommodate a filter strip due to the adjacent wetland proximity. This area will be treated with a storm filter media/compost filter system.

As noted above, roof downspout dispersal will be utilized for all buildings, as required

One other very important feature in the project is the density (0.09 lots/ac or 10.6 ac/lot). With the limitation on clearing, the proponent would be clearing a maximum of 39.14 acres or 20% of the 191.2 acre site (assuming 65% open space on Patterson Basin lots and 80% max clearing on remaining lots per RA-5 zoning code).

The "Basin Map" shows the on- & off-site basin areas, while Exhibit "S1" is the basin input data used for the KCRTS model. The "East & West Ponds" Map shows the locations of the onsite ponds. The East Pond is a wet pond. The water quality (WQ) volume requirements for the entire project are satisfied within the volume of the East Pond from the pond bottom elevation (74) to the bottom of the detention elevation (81.5). Between Elevations 81.5 to 85.17 both the East & West Ponds contribute the volume to be used for detention. Exhibit "S2" shows the available pond volume in tabular form. The Ponds will be connected hydraulically with a flat, 48"-diameter pipe as shown in the "East & West Ponds" Map. The detention requirement & orifice sizing were calculated by the KCRTS program. The program results are presented in tabular and graphical form.

The offsite basins will be routed through the ponds. . The KCRTS program was used to calculate the peak flows of the offsite basins. Note that per KCSWDM Pg 1-36, offsite bypass is required if the offsite existing 100 year flow is greater than 50% of the onsite developed 100 year flow. From the output data, the offsite existing 100-year flow is 6.97 cfs and the onsite developed 100-year flow is 16.18 cfs. For detention design modeling, offsite and onsite flows are combined and routed through the pond to establish orifice geometry. A control structure located within a 72"-diameter Manhole at the north end of the East Pond and East Pond Emergency Spillway will control flow of both ponds, see the "Pond Control Structure & Spillway Details" Exhibit. Exhibit "S5" presents the spillway sizing calculations in tabular form.

The estimated volume displaced per elevation of the East Pond is presented in tabular form in Exhibit "S3". The Exhibit "East Pond Surface Area per Elevation for Displaced Volume Calculation" shows the pond and associated fill areas within the flood plain. The flood plain corresponds to the 100-year flood line, approximately Elevation 82 across the pond. The total volume displaced by the pond is 95,000 cubic feet (cf).

FIGURE 3.2.1.D 100-YEAR 24-HOUR ISOPLUVIALS

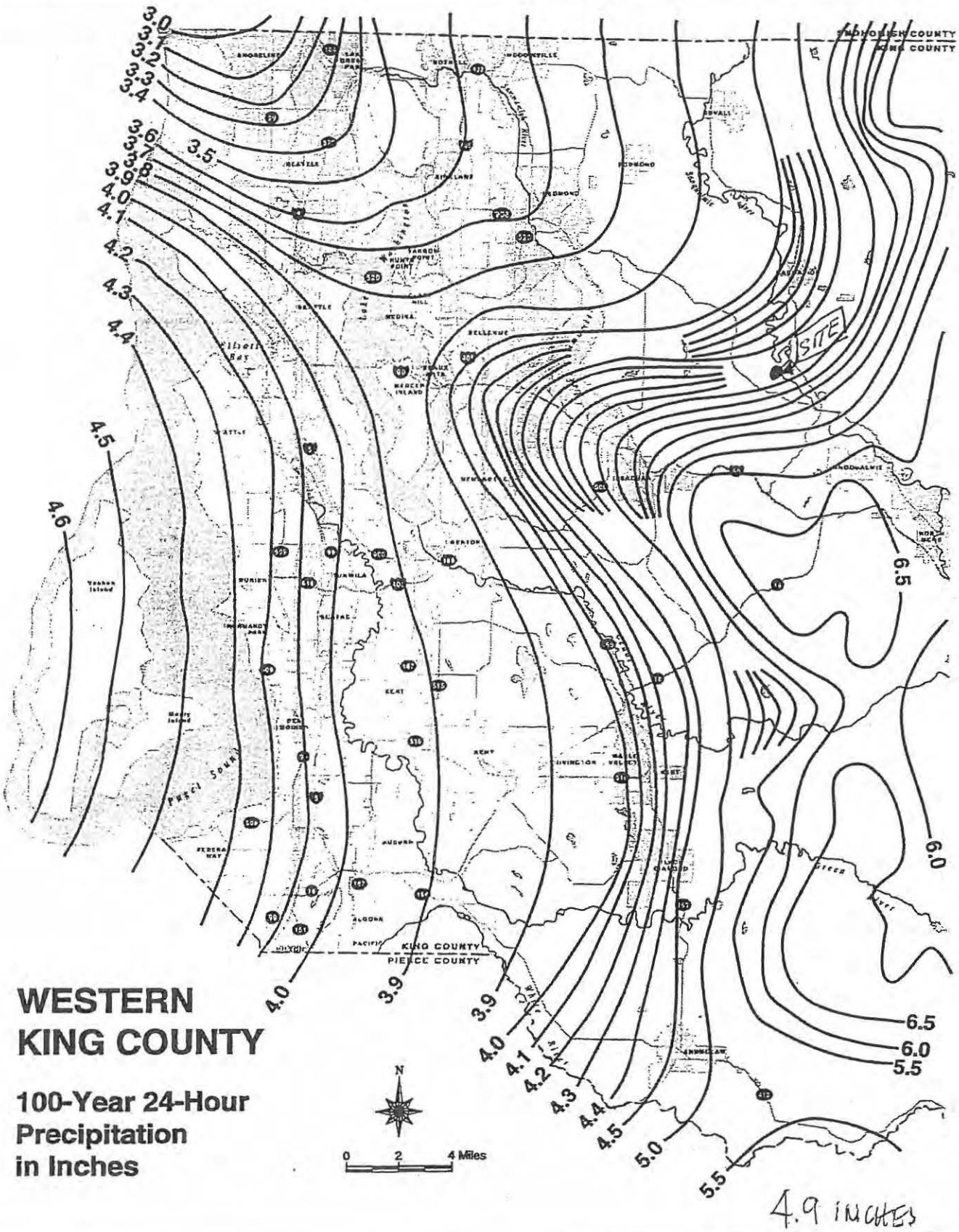
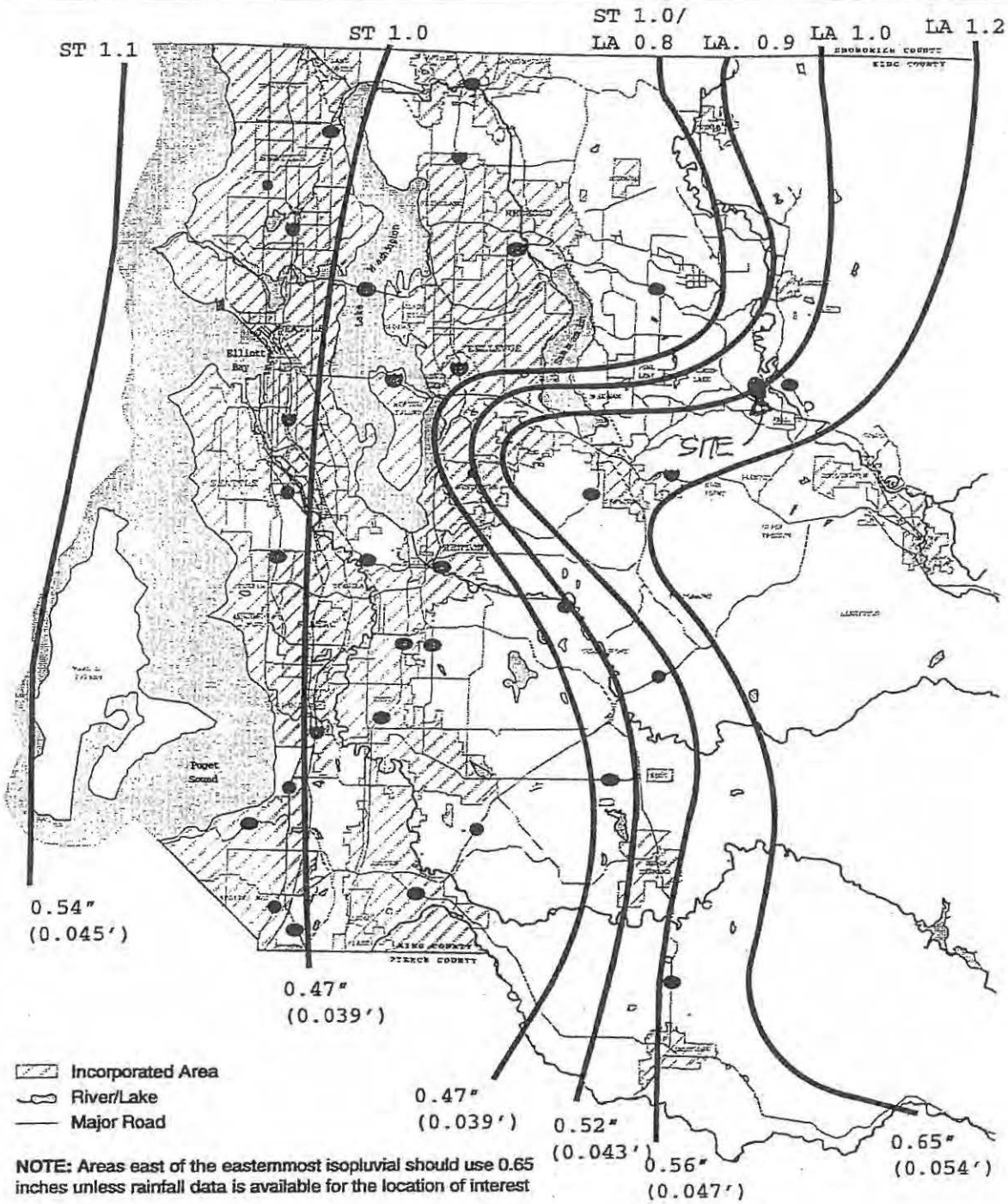


FIGURE 6.4.1.A PRECIPITATION FOR MEAN ANNUAL STORM IN INCHES (FEET)



NOTE: Areas east of the easternmost isopluvial should use 0.65 inches unless rainfall data is available for the location of interest

[24] The mean annual storm is a conceptual storm found by dividing the annual precipitation by the total number of storm events per year

result, generates large amounts of runoff. For this application, till soil types include Buckley and bedrock soils, and alluvial and outwash soils that have a seasonally high water table or are underlain at a shallow depth (less than 5 feet) by glacial till. U.S. Soil Conservation Service (SCS) hydrologic soil groups that are classified as till soils include a few B, most C, and all D soils. See Chapter 3 for classification of specific SCS soil types.

0.56" ✓

EXCERPT FROM
DRAFT FEMA
12/12/06

DATUM NAVD88

N

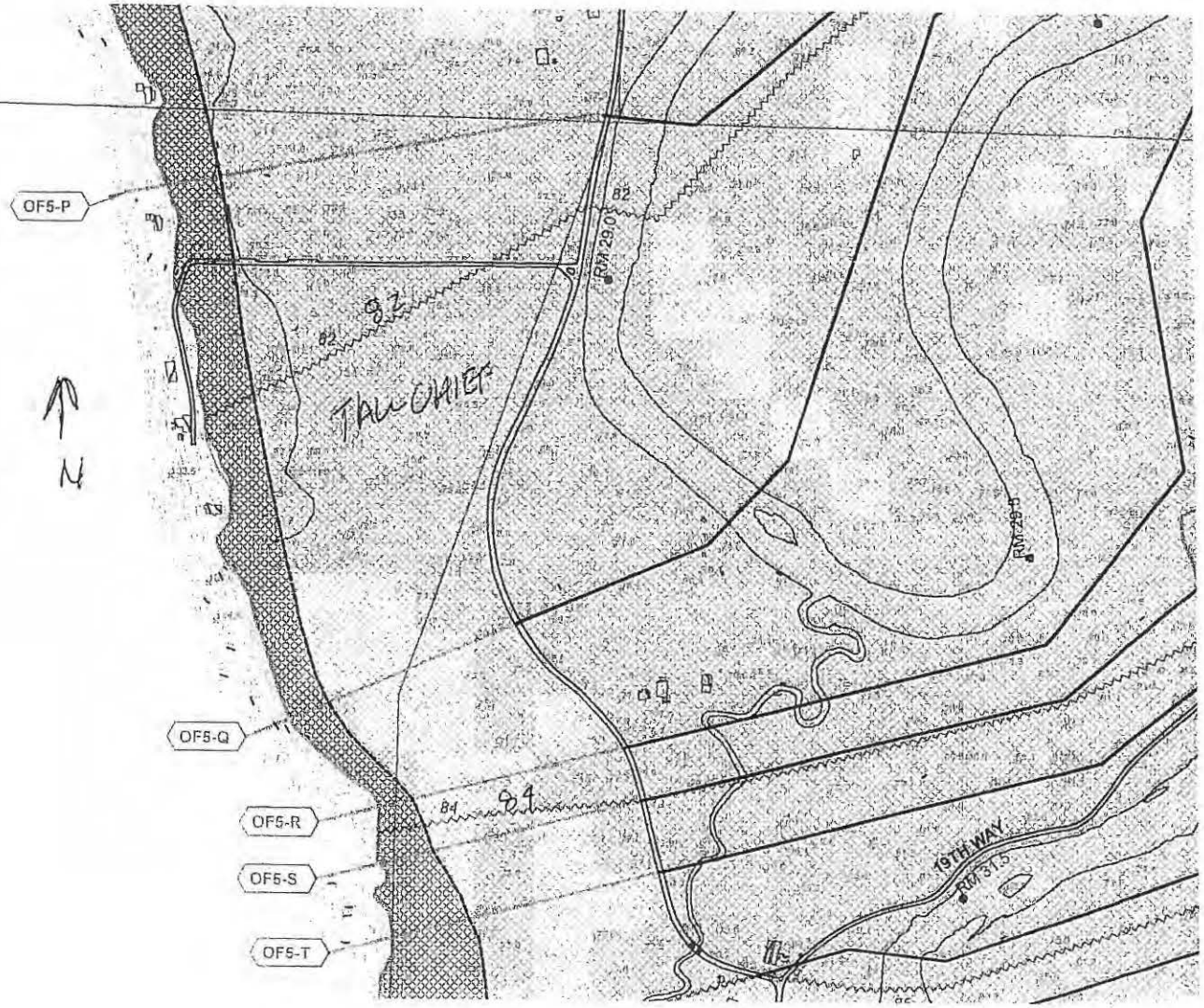
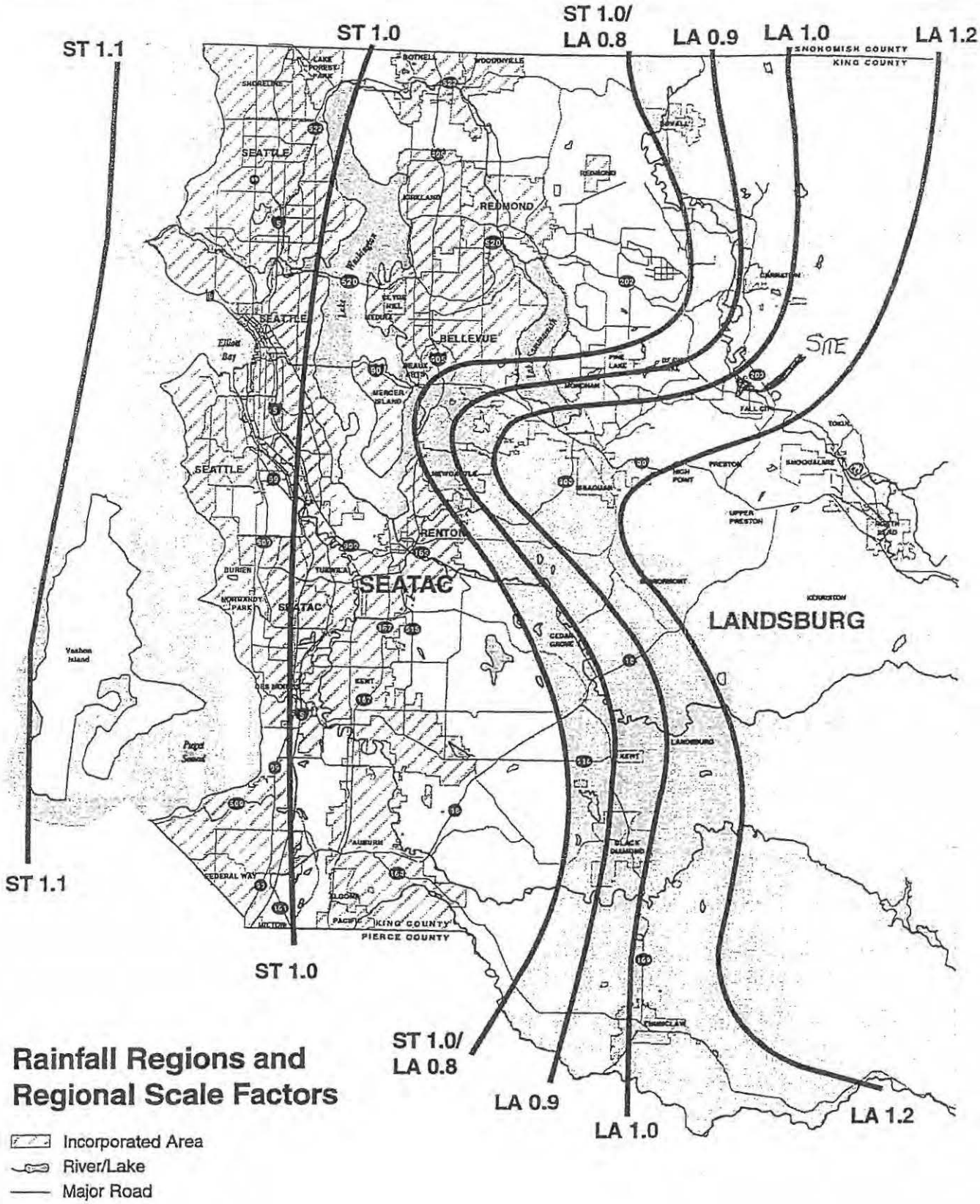
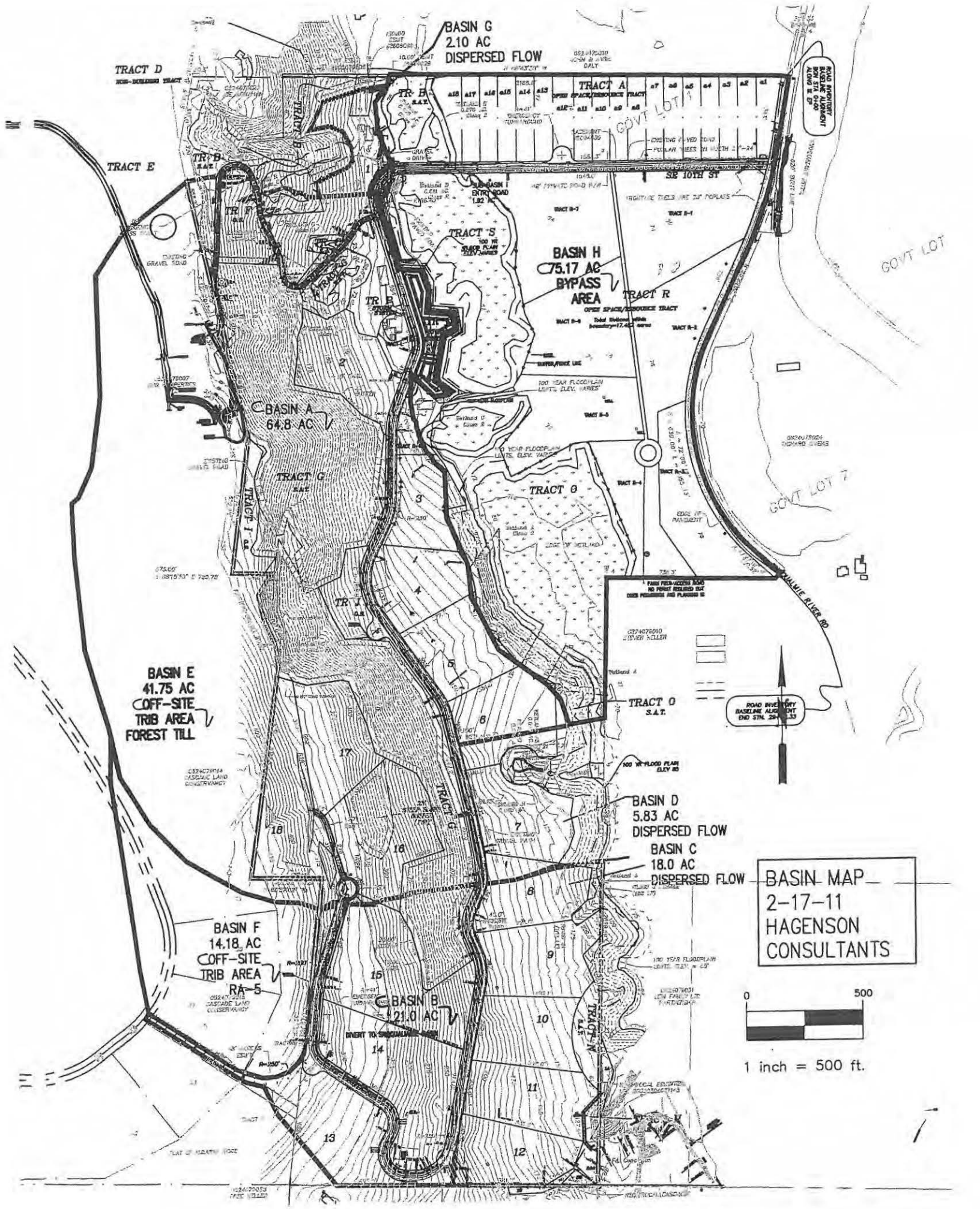


FIGURE 3.2.2.A RAINFALL REGIONS AND REGIONAL SCALE FACTORS




BASIN G
2.10 AC
DISPERSED FLOW
TRACT D
TRACT A
TRACT E
SE 10TH ST
BASIN H
75.17 AC
BYPASS
AREA
TRACT R
TRACT S
BASIN A
64.8 AC
TRACT G
TRACT O
GOVT LOT
GOVT LOT 7
PUYALLUP RIVER RD
BASIN E
41.75 AC
OFF-SITE
TRIB AREA
FOREST TILL
TRACT O
S.A.T.
BASIN D
5.83 AC
DISPERSED FLOW
BASIN C
18.0 AC
DISPERSED FLOW
BASIN F
14.18 AC
OFF-SITE
TRIB AREA
RA-5
BASIN B
21.0 AC
TRACT W
BASIN MAP
2-17-11
HAGENSON
CONSULTANTS
0
500
1 inch = 500 ft.

Premise: Assume Appellants successfully force project to provide DETENTION in LIEU OF DIRECT DISCHARGE

- Assume all Patterson Creek lots and all Sixty Basin lots have 65% open space
- Design vested to 1998 Manual.
- Site is Level 2 Flow control/Basic W.Q. area
- Soils Class C till (Ag & MK)
- Regional Scale Factor is LA 1.0.
- Hourly time steps.

STATISTICS FOR WETPOND & DETENTION DEVELOPED CONDITION

BASIN	IMPERV ROADS	IMPERV ROOF & DW	PERV LAWNS	PERV FORREST	# BLDG LOTS	TOTAL AREA
		*				
A	3.00 AC	29.5 AC of LOTS X20% = 5.9 AC X50% credit = 2.95	29.5 X 15% = 4.4 +2.95 = 7.35	Remainder 51.5 AC	9	67.9 AC
B	2.37 AC	15.2 AC of LOTS X20% = 3.04 X50% credit = 1.52	15.2 X 15% = 2.28 +1.52 = 3.8	Remainder 13.31 AC	3	21.0 AC
F OFFSITE	0.6 AC	6 AC LOTS X20% = 1.2 AC X 50% credit = 0.6	6 X 15% = 0.9 + 0.6 = 1.5	Remainder 11.5 AC	2 offsite	14.2 AC
E OFFSITE				41.75		41.75
Subtotals for wetpond DESIGN	5.97	5.07	12.65	118.1		141.79
BYPASS H	1.95 AC	⊖	73.22 (PASTURE)	⊖		75.17 AC
	7.92 AC	5.07	73.22 PAST, 12.65 LAWN	118.1		216.96

WETPOND DESIGN $f = 3$ wetpond factor
Pg 68-80-chap 6 R = ppt for mean annual storm (Fig 6.4.1.A) = 0.56"

$$V_r = 0.9A_i + 0.25A_{tg} + 0.1A_{tf} + 0.01A_o \times R/12 \times 43560$$
$$= 0.9(5.97+5.07) + 0.25(12.65) + 0.1(118.05) \times 0.56/12 \times 43560 = 50,624$$

V_b = Volume req'd for wetpond = $V_r \times 3$ = 151,871 CF

*: MMS 98 Section 5.2.2 - Roof infiltration and modeled as 100% grass versus 50% credit taken here. & Pg 3-36

x MAX IMPERV = 20% (RA-5 ZONE)

TALL CHIEF | PRELIM DETENTION DESIGN | 5-13-09

EXIST CONDITIONS

BASIN	IMPERV ROADS	IMPERV ROOF & DWD	PERV LAWNS	PERV FORREST	TOTAL
A	0.55AC	0.4AC	14.3	49.59	64.84
B	Ø	Ø	Ø	21.0	21.0
F	0.6	0.6	1.5	11.5	14.2
E				41.75	41.75
SUBTOTAL	1.15	1	15.8	123.84	141.79
H	1.29	Ø	73.88 (PASTURE)	Ø	75.17
TOTAL	2.44	1	73.88 PAST, 15.8 LAWN	123.84	216.96

WETPOND VOL REQD - 151,871 CF
DETENTION REQD PER SPREADSHEET - 187,657 CF } 339,528

POND EL	AREA	VOLUME TOTAL
374	11120 SF	Ø
378	19,612 SF	61,464
378	20,000 SF	61464
383	33288 SF	194684
385	38839	267400
387	44528	351,843

WETPOND EL 381.39

FP @ EL 82

APPROX MAX WS ELEV 85.4

CURRENT FEMA FIRM # 53033C0710G & 0709G REVISED MAY 20 96

SHOWS fp @ EL 80 NGVD @ pond site - confirm w/ SURVEYOR.
NOTE - LEFT MESSAGE w/ DOUG HANSEN 5-12-09

NOTE FP @ EL 82 USING DATUM PER SURVEYOR.

NOTE - PER SWM. VOL < 10 AC FT, PROJECT IS exempt from DAM compliance (DS ILLSWM pg 5-17)

Tall Chief 2-17-11

```
KCRTS

                King County Runoff Time Series Program

                          Version 6.00
All files will be read/written in the Working Directory
Working Directory:C:\kc_swdm\output
-------------------------------------------------------------------------
                          KCRTS Command

                       CREATE a new Time Series

                   Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : predev.tsf
Regional Scale Factor :    1.00
          Data Type : Reduced
Creating Hourly Time Series File
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60R.rnf   8
Till Forest       123.84 acres                Scaling  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATP60R.rnf   8
Till Pasture       73.88 acres            Adding  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60R.rnf   8
Till Grass         15.80 acres            Adding  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf   8
Impervious          3.44 acres            Adding  Yr: 8

       Total Area :  216.96 acres
Peak Discharge:  34.55 CFS at  7:00 on Jan  9 in Year 8
                                Storing Time Series File:predev.tsf   8

                       Time Series Computed
-------------------------------------------------------------------------
                          KCRTS Command

                       CREATE a new Time Series

                   Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : dev.tsf
Regional Scale Factor :    1.00
          Data Type : Reduced
Creating Hourly Time Series File
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60R.rnf   8
Till Forest       118.10 acres                Scaling  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60R.rnf   8
Till Grass         12.65 acres            Adding  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf   8
Impervious         11.04 acres            Adding  Yr: 8

       Total Area :  141.79 acres
Peak Discharge:  23.14 CFS at  7:00 on Jan  9 in Year 8
                                Storing Time Series File:dev.tsf   8

                       Time Series Computed
```

KCRTS Command

CREATE a new Time Series

```
                Production of Runoff Time Series
   Project Location : Landsburg
     Computing Series : rdin.tsf
Regional Scale Factor :    1.00
          Data Type : Reduced
Creating Hourly Time Series File
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60R.rnf   8
Till Forest       118.10 acres              Scaling  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60R.rnf   8
Till Grass         12.65 acres          Adding  Yr: 8
                Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf   8
Impervious         11.04 acres          Adding  Yr: 8

       Total Area :  141.79 acres
Peak Discharge:  23.14 CFS at  7:00 on Jan  9 in Year 8
                                Storing Time Series File:rdin.tsf   8

                Time Series Computed
```

KCRTS Main Menu

- INFORMATION about this program
- CREATE a new Time Series
- Define a 1 outlet Reservoir
- Route through a SINGLE (1) outlet Reservoir
- Define a 2 outlet Reservoir
- Route through a DOUBLE (2) outlet Reservoir
- ADD Time Series
- Add a BASEFLOW to a Time Series
- Size a Retention/Detention FACILITY
- Enter the Analysis TOOLS Module
- eXit KCRTS Program

Enter land use areas to compute runoff

```
                    Time Series Computed
____________________________________________________

                    KCRTS Command
                    -------------
                   CREATE a new Time Series
                   ------------------------

                 Production of Runoff Time Series
   Project Location : Landsburg
     Computing Series : bypass.tsf
Regional Scale Factor :    1.00
          Data Type : Reduced
Creating Hourly Time Series File
                 Loading Time Series File:C:\KC_SWDM\KC_DATA\LATP60R.rnf   8
Till Pasture        73.22 acres              Scaling  Yr: 8
                 Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf   8
Impervious           1.95 acres          Adding  Yr: 8
                 ---------
       Total Area :   75.17 acres
Peak Discharge:  14.73 CFS at  7:00 on Jan  9 in Year 8
                                   Storing Time Series File:bypass.tsf   8

                    Time Series Computed
```

Add a BASEFLOW to a Time Series

Size a Retention/Detention FACILITY

Enter the Analysis TOOLS Module

eXit KCRTS Program

Enter land use areas to compute runoff

```
Impervious          11.04 acres          Adding Yr: 8

        Total Area :  141.79 acres
Peak Discharge:  23.14 CFS at  7:00 on Jan  9 in Year 8
                                   Storing Time Series File:rdin.tsf   8

                        Time Series Computed
____________________________________________________________________
                          KCRTS Command

                       Enter the Analysis TOOLS Module

____________________________________________________________________
                       Analysis Tools Command

                     Compute PEAKS and Flow Frequencies

                                 Loading Time Series File:predev.tsf   8
      Flow Frequency Analysis
____________________________________________________________________
 Time Series File:predev.tsf
 Project Location:Landsburg
                           Frequencies & Peaks saved to File:predev.pks
```

Help/Files - KCRTS

Flow Frequency Analysis

Time Series File:predev.tsf
Project Location:Landsburg

—Annual Peak Flow Rates—			—Flow Frequency Analysis—			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
21.46	2	2/09/01 14:00	34.55	1	100.00	0.990
5.04	8	1/05/02 16:00	21.46	2	25.00	0.960
14.48	4	2/28/03 16:00	19.03	3	10.00	0.900
7.09	7	8/26/04 1:00	14.48	4	5.00	0.800
13.37	5	1/05/05 10:00	13.37	5	3.00	0.667
10.69	6	1/18/06 21:00	10.69	6	2.00	0.500
19.03	3	11/24/06 5:00	7.09	7	1.30	0.231
34.55	1	1/09/08 7:00	5.04	8	1.10	0.091
Computed Peaks			30.19		50.00	0.980

start Inbox - Microsof... AutoCAD 2002 -... KCRTS Input (C... KCRTS KCRTS Model 2 -... OUTPUT Search Desktop 3:45 PM

Analysis Tools Command

Compute PEAKS and Flow Frequencies

Loading Time Series File:predev.tsf 8

Flow Frequency Analysis

Time Series File:predev.tsf
Project Location:Landsburg

Frequencies & Peaks saved to File:predev.pks :

Analysis Tools Command

Compute PEAKS and Flow Frequencies

Loading Time Series File:rdin.tsf 8

Flow Frequency Analysis

Time Series File:rdin.tsf
Project Location:Landsburg

Frequencies & Peaks saved to File:rdin.pks :

13.37	5	1/05/05 10:00	13.37	5	3.00	0.667
10.69	6	1/18/06 21:00	10.69	6	2.00	0.500
19.03	3	11/24/06 5:00	7.09	7	1.30	0.231
34.55	1	1/09/08 7:00	5.04	8	1.10	0.091
Computed Peaks			30.19		50.00	0.980

Flow Frequency Analysis

Time Series File:rdin.tsf
Project Location:Landsburg

—Annual Peak Flow Rates—			—Flow Frequency Analysis—			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
14.87	2	2/09/01 14:00	23.14	1	100.00	0.990
4.28	8	1/05/02 16:00	14.87	2	25.00	0.960
10.40	4	2/28/03 16:00	13.25	3	10.00	0.900
6.05	7	8/26/04 1:00	10.40	4	5.00	0.800
9.57	5	1/05/05 10:00	9.57	5	3.00	0.667
7.66	6	1/18/06 16:00	7.66	6	2.00	0.500
13.25	3	11/24/06 5:00	6.05	7	1.30	0.231
23.14	1	1/09/08 7:00	4.28	8	1.10	0.091

Frequencies & Peaks saved to File:predev.pks :

Analysis Tools Command

Compute PEAKS and Flow Frequencies

Loading Time Series File:rdin.tsf 8

Flow Frequency Analysis

Time Series File:rdin.tsf
Project Location:Landsburg

Frequencies & Peaks saved to File:rdin.pks :

Analysis Tools Command

Compute PEAKS and Flow Frequencies

Loading Time Series File:bypass.tsf 8

Flow Frequency Analysis

Time Series File:bypass.tsf
Project Location:Landsburg

Frequencies & Peaks saved to File:bypass.pks :

Help / Files: KCRTS

13.25	3	11/24/06 5:00	6.05	7	1.30	0.231
23.14	1	1/09/08 7:00	4.28	8	1.10	0.091
Computed Peaks			20.38		50.00	0.980

Flow Frequency Analysis

Time Series File:bypass.tsf
Project Location:Landsburg

—Annual Peak Flow Rates—			——Flow Frequency Analysis——			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
7.95	3	2/09/01 14:00	14.73	1	100.00	0.990
2.16	8	1/05/02 16:00	7.99	2	25.00	0.960
5.40	4	2/28/03 16:00	7.95	3	10.00	0.900
4.70	6	8/26/04 1:00	5.40	4	5.00	0.800
5.10	5	1/05/05 10:00	5.10	5	3.00	0.667
4.07	7	1/18/06 21:00	4.70	6	2.00	0.500
7.99	2	11/21/06 9:00	4.07	7	1.30	0.231
14.73	1	1/09/08 7:00	2.16	8	1.10	0.091
Computed Peaks			12.48		50.00	0.980

Start | Inbox - Microsof... | AutoCAD 2002 -... | KCRTS input [C... | KCRTS | KCRTS Model 2-... | OUTPUT | Search Desktop | 3:46 PM

Flow Frequency Analysis

Time Series File:bypass.tsf
Project Location:Landsburg
Frequencies & Peaks saved to File:bypass.pks :

Analysis Tools Command

RETURN to Previous Menu

KCRTS Command

Enter the Analysis TOOLS Module

Analysis Tools Command

Compute Flow DURATION and Exceedence

Loading Time Series File:predev.tsf 8
Computing Flow DurationsCompleted Yr: 7
Durations & Exceedence Probabilities to File:target.dur :

Help/ Files- KCRTS

14.73	1	1/09/08 7:00	2.16	8	1.10	0.091
Computed Peaks			12.48		50.00	0.980

Computing Durations:
Flow Duration from Time Series File:predev.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
5.34	60724	99.028	99.028	0.972	0.972E-02
6.89	230	0.375	99.403	0.597	0.597E-02
8.44	150	0.245	99.648	0.352	0.352E-02
9.99	90	0.147	99.795	0.205	0.205E-02
11.55	44	0.072	99.866	0.134	0.134E-02
13.10	26	0.042	99.909	0.091	0.913E-03
14.65	16	0.026	99.935	0.065	0.652E-03
16.19	15	0.024	99.959	0.041	0.408E-03
17.74	13	0.021	99.980	0.020	0.196E-03
19.29	7	0.011	99.992	0.008	0.815E-04
20.84	2	0.003	99.995	0.005	0.489E-04
22.39	3	0.005	100.000	0.000	0.000E+00
23.94	0	0.000	100.000	0.000	0.000E+00

Start Inbox - Microsof... AutoCAD 2002 - ... KCRTS Input (C... KCRTS Model 2... OUTPUT 3:55 PM

KCRTS Command

Size a Retention/Detention FACILITY

Edit Facility

```
                                   Loading Time Series File:rdin.tsf   8
                                   Loading Time Series File:rdin.tsf   8
                                 Loading Time Series File:bypass.tsf   8
                Hyd Year  Inflow  Outflow  Pk:Stage Pk:Elev  Strg:Cu-Ft   Ac-Ft
 Bypass         1   8    23.14    22.39      3.84    3.84      34282.    0.787
 [illegible]
 Orifice Q      3   7    13.25    12.07      2.58    2.58      21751.    0.499
                4   3    10.40     9.69      1.66    1.66      13420.    0.308
                5   5     9.57     9.23      1.51    1.51      12073.    0.277
                6   6     7.66     7.39      0.97    0.97       7548.    0.173
1    14.067     7   4     6.05     5.32      0.50    0.50       3822.    0.088
T    14.067     8   2     4.28     3.96      0.28    0.28       2105.    0.048
Hyd Year  R/D Facility  Tributary  Reservoir   POC Outflow
          Outflow       Inflow     Inflow      Target    Calc
 1   8      22.39        14.73     ********    *******   35.70
 [illegible]
 3   7      12.07         7.99     ********    *******   18.28
 4   3       9.69         5.40     ********    *******   14.17
 5   5       9.23         5.10     ********    *******   13.97
 6   6       7.39         4.07     ********    *******   11.11
 7   4       5.32         4.70     ********    *******    8.06
 8   2       3.96         2.16     ********    *******    5.49
                     Saving Retention/Detention Facility File:pond.rdf   :
                  Starting Documentation File:C:\kc_svda\output\pond.doc   :
                              Time Series Found in Memory:rdin.tsf   :
                              Loading Time Series File:bypass.tsf   8

                          Edit Complete
```

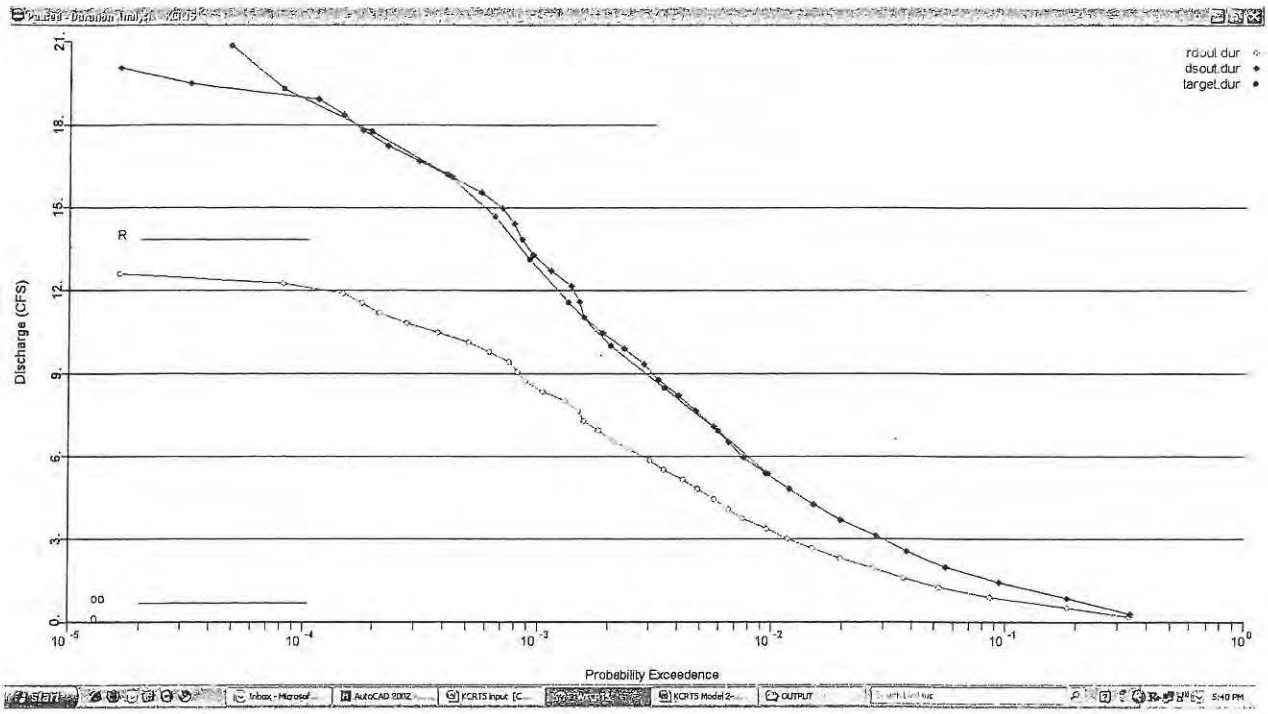
```
Step:7a          Select dates for Iteration Hydrograph
Ranked peaks that have changed:
None
Step:7b          Route Timeseries to Point of Compliance
Route Time Series   Full Riser Discharge:0.
Route Time Series   Full Riser Discharge:12.66
Route Time Series   Full Riser Discharge:14.0681
Route Time Series   Full Riser Discharge:13.364
Route Time Series   Full Riser Discharge:13.978
Route Time Series   Full Riser Discharge:14.0555
Route Time Series   Full Riser Discharge:14.0653
Route Time Series   Full Riser Discharge:14.0667
Q:14.0653 Peak Stage:3.5
Route Time Series   Facility Length=122.082
Trial      Area    Storage-Avail Storage-Used    Target    Result
  15      7452.0     30797.191     30799.199    21.460    21.459
Step:7a          Select dates for Iteration Hydrograph
Ranked peaks that have changed:
None
```

```
  17.71 |  0.20E-03  0.18E-03   -8.3 |  0.20E-03   17.71   17.44   -1.5
  18.95 |  0.13E-03  0.11E-03  -12.5 |  0.13E-03   18.95   18.87   -0.4
  20.19 |  0.49E-04  0.00E+00 -100.0 |  0.49E-04   20.19   19.45   -3.6
  21.43 |  0.33E-04  0.00E+00 -100.0 |  0.33E-04   21.43   19.61   -8.5

Maximum positive excursion = 0.775 cfs (  6.8%)
occurring at 11.35 cfs on the Base Data:predev.tsf
and at 12.13 cfs on the  New Data:dsout.tsf

Maximum negative excursion = 1.86 cfs ( -8.7%)
occurring at 21.31 cfs on the Base Data:predev.tsf
and at 19.45 cfs on the  New Data:dsout.tsf
        Type of Facility: Detention Pond
             Side Slope:        0.10  H:1V
     Pond Bottom Length:      262.00  ft
      Pond Bottom Width:      262.00  ft
       Pond Bottom Area:    68644.    sq. ft
   Top Area at 1 ft. FB:    69116.    sq. ft
                             1.587 acres
 Effective Storage Depth:       3.50  ft
      Stage 0 Elevation:        0.00  ft
         Storage Volume:   240896.    cu. ft
                             5.530 ac-ft
             Riser Head:        3.50  ft
          Riser Diameter:      48.00  inches
     Number of orifices:        2
                                     Full Head    Pipe
   Orifice #      Height  Diameter  Discharge  Diameter
                   (ft)     (in)      (CFS)      (in)
      1            0.00     6.00       1.826
      2            0.50    16.00      12.024     21.0
        Top Notch Weir: None
   Outflow Rating Curve: None

        Type of Facility: Detention Pond
             Side Slope:        0.10  H:1V
     Pond Bottom Length:      262.00  ft
      Pond Bottom Width:      262.00  ft
       Pond Bottom Area:    68644.    sq. ft
   Top Area at 1 ft. FB:    69116.    sq. ft
                             1.587 acres
 Effective Storage Depth:       3.50  ft
      Stage 0 Elevation:        0.00  ft
         Storage Volume:   240896.    cu. ft
                             5.530 ac-ft
             Riser Head:        3.50  ft
          Riser Diameter:      48.00  inches
     Number of orifices:        2
                                     Full Head    Pipe
   Orifice #      Height  Diameter  Discharge  Diameter
                   (ft)     (in)      (CFS)      (in)
      1            0.00     6.00       1.826
      2            0.50    16.00      12.024     21.0
        Top Notch Weir: None
   Outflow Rating Curve: None
Click Right Mouse Button or Press Any Key to continue
```


rdout.dur
dsout.dur
target.dur
Discharge (CFS)
Probability Exceedence
R
00
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10^{-5}
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10^{-2}
10^{-1}
10^{0}

```
                    Reservoir Routing [R/D Facility]
 Years Complete:  8
                         Inflow/Outflow Analysis
                         -----------------------

  Peak Inflow Discharge:      23.14 CFS at  7:00 on Jan  9 in Year 8
 Peak Outflow Discharge:      17.10 CFS at 12:00 on Jan  9 in Year 8
   Peak Reservoir Stage:       3.67  Ft
    Peak Reservoir Elev:       3.67  Ft
 Peak Reservoir Storage:  252806.    Cu-Ft
                    :        5.804 Ac-Ft
                                 Storing Time Series File:rdout.tsf   8
Add Time Series:bypass.tsf
  Peak Summed Discharge:      28.13 CFS at 11:00 on Jan  9 in Year 8
                                 Storing Time Series File:dsout.tsf   8Completed  Yr: 7
                 Durations & Exceedence Probabilities to File:rdout.dur   :

                Duration Calculation..Point of Compliance
                                 Loading Time Series File:dsout.tsf   8
Computing Interval Locations
Computing Flow Durations
Computing Durations:Completed  Yr: 7
                 Durations & Exceedence Probabilities to File:dsout.dur   :

                      Duration Plotting
                            Loading Flow Duration File:rdout.dur   :
```

```
Computing Flow Durations
Computing Durations:
                    Duration Comparison Anaylsis
                    ----------------------------

  Base File: predev.tsf
   New File: dsout.tsf
Cutoff Units: Discharge in CFS
```

	Fraction of Time			Check of Tolerance			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
5.31	0.98E-02	0.97E-02	-0.7	0.98E-02	5.31	5.30	-0.2
6.55	0.66E-02	0.65E-02	-1.7	0.66E-02	6.55	6.46	-1.4
7.79	0.44E-02	0.46E-02	5.2	0.44E-02	7.79	7.90	1.5
9.03	0.29E-02	0.31E-02	6.8	0.29E-02	9.03	9.28	2.8
10.27	0.19E-02	0.20E-02	9.6	0.19E-02	10.27	10.63	3.5
11.51	0.14E-02	0.15E-02	13.3	0.14E-02	11.51	12.20	6.1
12.75	0.98E-03	0.11E-02	13.3	0.98E-03	12.75	13.13	3.0
13.99	0.77E-03	0.82E-03	6.4	0.77E-03	13.99	14.68	5.0
15.23	0.55E-03	0.65E-03	17.6	0.55E-03	15.23	15.61	2.5
16.47	0.38E-03	0.36E-03	-4.3	0.38E-03	16.47	16.31	-0.9
17.71	0.20E-03	0.18E-03	-8.3	0.20E-03	17.71	17.44	-1.5
18.95	0.13E-03	0.11E-03	-12.5	0.13E-03	18.95	18.87	-0.4
20.19	0.49E-04	0.00E+00	-100.0	0.49E-04	20.19	19.45	-3.6
21.43	0.33E-04	0.00E+00	-100.0	0.33E-04	21.43	19.61	-8.5

```
Maximum positive excursion = 0.775 cfs (  6.8%)
occurring at 11.35 cfs on the Base Data:predev.tsf
and at 12.13 cfs on the  New Data:dsout.tsf
```

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Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	0.10	H:1V
Pond Bottom Length:	262.00	ft
Pond Bottom Width:	262.00	ft
Pond Bottom Area:	68644.	sq. ft
Top Area at 1 ft. FB:	69116.	sq. ft
	1.587	acres
Effective Storage Depth:	3.50	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	240896.	cu. ft
	5.530	ac-ft
Riser Head:	3.50	ft
Riser Diameter:	48.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	6.00	1.826	
2	0.50	16.00	12.024	21.0

Top Notch Weir: None

Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	0.00	0.	0.000	0.000	0.00	68644.
0.06	0.06	4119.	0.095	0.244	0.00	68650.
0.13	0.13	8925.	0.205	0.345	0.00	68658.
0.19	0.19	13044.	0.299	0.423	0.00	68664.
0.25	0.25	17164.	0.394	0.488	0.00	68670.
0.31	0.31	21285.	0.489	0.546	0.00	68676.
0.38	0.38	26092.	0.599	0.598	0.00	68684.
0.44	0.44	30214.	0.694	0.646	0.00	68690.
0.50	0.50	34335.	0.788	0.690	0.00	68696.
0.60	0.60	41205.	0.946	0.801	0.00	68707.
0.70	0.70	48076.	1.104	0.996	0.00	68717.

0.80	0.80	54949.	1.261	1.270	0.00	68728.
0.90	0.90	61822.	1.419	1.630	0.00	68738.
1.00	1.00	68696.	1.577	2.050	0.00	68749.
1.10	1.10	75572.	1.735	2.540	0.00	68759.
1.20	1.20	82448.	1.893	3.110	0.00	68770.
1.30	1.30	89326.	2.051	3.740	0.00	68780.
1.40	1.40	96204.	2.209	7.740	0.00	68791.
1.50	1.50	103084.	2.366	8.140	0.00	68801.
1.60	1.60	109965.	2.524	8.520	0.00	68812.
1.70	1.70	116846.	2.682	8.880	0.00	68822.
1.80	1.80	123729.	2.840	9.230	0.00	68833.
1.90	1.90	130613.	2.998	9.560	0.00	68843.
2.00	2.00	137498.	3.157	9.890	0.00	68854.
2.10	2.10	144384.	3.315	10.200	0.00	68864.
2.20	2.20	151271.	3.473	10.500	0.00	68875.
2.30	2.30	158159.	3.631	10.800	0.00	68885.
2.40	2.40	165048.	3.789	11.080	0.00	68896.
2.50	2.50	171938.	3.947	11.360	0.00	68906.
2.60	2.60	178829.	4.105	11.640	0.00	68917.
2.70	2.70	185721.	4.264	11.900	0.00	68927.
2.80	2.80	192614.	4.422	12.160	0.00	68938.
2.90	2.90	199509.	4.580	12.420	0.00	68948.
3.00	3.00	206404.	4.738	12.670	0.00	68959.
3.10	3.10	213300.	4.897	12.920	0.00	68969.
3.20	3.20	220198.	5.055	13.160	0.00	68980.
3.30	3.30	227096.	5.213	13.390	0.00	68990.
3.40	3.40	233996.	5.372	13.630	0.00	69001.

3.50	3.50	240896.	5.530	13.850	0.00	69011.
3.60	3.60	247798.	5.689	15.310	0.00	69022.
3.70	3.70	254701.	5.847	17.780	0.00	69032.
3.80	3.80	261605.	6.006	20.920	0.00	69043.
3.90	3.90	268509.	6.164	24.590	0.00	69053.
4.00	4.00	275415.	6.323	28.720	0.00	69064.
4.10	4.10	282322.	6.481	33.260	0.00	69074.
4.20	4.20	289230.	6.640	38.170	0.00	69085.
4.30	4.30	296139.	6.798	43.440	0.00	69095.
4.40	4.40	303049.	6.957	49.020	0.00	69106.
4.50	4.50	309960.	7.116	54.920	0.00	69116.
4.60	4.60	316872.	7.274	61.100	0.00	69127.
4.70	4.70	323786.	7.433	67.560	0.00	69137.
4.80	4.80	330700.	7.592	74.280	0.00	69148.
4.90	4.90	337615.	7.751	81.260	0.00	69158.
5.00	5.00	344532.	7.909	88.480	0.00	69169.
5.10	5.10	351449.	8.068	93.640	0.00	69180.
5.20	5.20	358368.	8.227	96.180	0.00	69190.
5.30	5.30	365287.	8.386	98.650	0.00	69201.
5.40	5.40	372208.	8.545	101.050	0.00	69211.
5.50	5.50	379129.	8.704	103.390	0.00	69222.

Hyd	Inflow	Outflow	Peak Stage	Peak Elev	Storage (Cu-Ft)	Storage (Ac-Ft)
1	23.14	17.10	3.67	3.67	252806.	5.804
2	14.87	12.63	2.98	2.98	205307.	4.713
3	13.25	10.55	2.22	2.22	152422.	3.499
4	10.40	8.37	1.56	1.56	107259.	2.462
5	9.57	8.29	1.54	1.54	105806.	2.429
6	7.66	7.38	1.39	1.39	95591.	2.194
7	6.05	0.93	0.66	0.66	45670.	1.048
8	4.28	1.95	0.98	0.98	67093.	1.540

Hyd	R/D Facility Outflow	Tributary Inflow	Reservoir Inflow	POC Outflow Target	Calc
1	17.10	14.73	********	*******	28.14
2	12.63	7.95	********	21.46	20.08
3	10.55	7.99	********	*******	17.41
4	8.37	5.40	********	*******	13.37
5	8.29	5.10	********	*******	13.13
6	7.38	4.07	********	*******	11.14
7	0.93	4.70	********	*******	5.14
8	1.95	2.16	********	*******	3.18

Route Time Series through Facility
Inflow Time Series File:rdin.tsf
Outflow Time Series File:rdout
POC Time Series File:dsout

Inflow/Outflow Analysis
Peak Inflow Discharge: 23.14 CFS at 7:00 on Jan 9 in Year 8
Peak Outflow Discharge: 17.10 CFS at 12:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.67 Ft
Peak Reservoir Elev: 3.67 Ft
Peak Reservoir Storage: 252806. Cu-Ft
: 5.804 Ac-Ft

Add Time Series:bypass.tsf
Peak Summed Discharge: 28.13 CFS at 11:00 on Jan 9 in Year 8
Point of Compliance File:dsout.tsf

Flow Duration from Time Series File:rdout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.180	40594	66.200	66.200	33.800	0.338E+00
0.535	9446	15.404	81.605	18.395	0.184E+00
0.890	6010	9.801	91.406	8.594	0.859E-01
1.25	2068	3.372	94.778	5.222	0.522E-01
1.60	953	1.554	96.332	3.668	0.367E-01
1.96	589	0.961	97.293	2.707	0.271E-01
2.31	455	0.742	98.035	1.965	0.197E-01
2.67	288	0.470	98.505	1.495	0.150E-01
3.02	195	0.318	98.823	1.177	0.118E-01
3.38	133	0.217	99.039	0.961	0.961E-02
3.73	124	0.202	99.242	0.758	0.758E-02
4.09	63	0.103	99.344	0.656	0.656E-02
4.44	51	0.083	99.428	0.572	0.572E-02
4.80	51	0.083	99.511	0.489	0.489E-02
5.15	42	0.068	99.579	0.421	0.421E-02
5.51	44	0.072	99.651	0.349	0.349E-02
5.86	28	0.046	99.697	0.303	0.303E-02
6.22	33	0.054	99.750	0.250	0.250E-02
6.57	25	0.041	99.791	0.209	0.209E-02
6.93	17	0.028	99.819	0.181	0.181E-02
7.28	15	0.024	99.843	0.157	0.157E-02
7.64	5	0.008	99.852	0.148	0.148E-02

7.99	11	0.018	99.870	0.130	0.130E-02
8.35	16	0.026	99.896	0.104	0.104E-02
8.70	10	0.016	99.912	0.088	0.881E-03
9.06	4	0.007	99.918	0.082	0.815E-03
9.41	4	0.007	99.925	0.075	0.750E-03
9.77	8	0.013	99.938	0.062	0.620E-03
10.12	7	0.011	99.949	0.051	0.506E-03
10.48	8	0.013	99.962	0.038	0.375E-03
10.83	6	0.010	99.972	0.028	0.277E-03
11.19	4	0.007	99.979	0.021	0.212E-03
11.55	2	0.003	99.982	0.018	0.179E-03
11.90	2	0.003	99.985	0.015	0.147E-03
12.26	4	0.007	99.992	0.008	0.815E-04
12.61	4	0.007	99.998	0.002	0.163E-04

Flow Duration from Time Series File:dsout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence %	Probability
0.287	40509	66.062	66.062	33.938	0.339E+00
0.852	9542	15.561	81.623	18.377	0.184E+00
1.42	5477	8.932	90.554	9.446	0.945E-01
1.98	2391	3.899	94.454	5.546	0.555E-01
2.55	1073	1.750	96.204	3.796	0.380E-01
3.11	623	1.016	97.220	2.780	0.278E-01
3.68	489	0.797	98.017	1.983	0.198E-01
4.24	283	0.462	98.478	1.522	0.152E-01
4.81	195	0.318	98.796	1.204	0.120E-01
5.37	155	0.253	99.049	0.951	0.951E-02
5.94	116	0.189	99.238	0.762	0.762E-02
6.50	65	0.106	99.344	0.656	0.656E-02
7.07	54	0.088	99.432	0.568	0.568E-02
7.63	55	0.090	99.522	0.478	0.478E-02
8.20	45	0.073	99.596	0.404	0.404E-02
8.76	45	0.073	99.669	0.331	0.331E-02
9.33	28	0.046	99.715	0.285	0.285E-02
9.89	32	0.052	99.767	0.233	0.233E-02
10.46	27	0.044	99.811	0.189	0.189E-02
11.02	20	0.033	99.843	0.157	0.157E-02
11.59	4	0.007	99.850	0.150	0.150E-02
12.15	8	0.013	99.863	0.137	0.137E-02
12.72	15	0.024	99.887	0.113	0.113E-02
13.28	11	0.018	99.905	0.095	0.946E-03
13.85	6	0.010	99.915	0.085	0.848E-03
14.41	4	0.007	99.922	0.078	0.783E-03
14.98	5	0.008	99.930	0.070	0.701E-03
15.54	8	0.013	99.943	0.057	0.571E-03
16.11	9	0.015	99.958	0.042	0.424E-03
16.67	7	0.011	99.969	0.031	0.310E-03
17.24	5	0.008	99.977	0.023	0.228E-03
17.80	3	0.005	99.982	0.018	0.179E-03
18.37	2	0.003	99.985	0.015	0.147E-03
18.93	2	0.003	99.989	0.011	0.114E-03
19.50	5	0.008	99.997	0.003	0.326E-04
20.06	1	0.002	99.998	0.002	0.163E-04

```
-----------------------------------
Route Time Series through Facility
  Inflow Time Series File:rdin.tsf
 Outflow Time Series File:rdout
     POC Time Series File:dsout

Inflow/Outflow Analysis
   Peak Inflow Discharge:       23.14 CFS at  7:00 on Jan  9 in Year 8
  Peak Outflow Discharge:       17.10 CFS at 12:00 on Jan  9 in Year 8
    Peak Reservoir Stage:        3.67  Ft
     Peak Reservoir Elev:        3.67  Ft
  Peak Reservoir Storage:  252806.    Cu-Ft
                        :       5.804 Ac-Ft

Add Time Series:bypass.tsf
   Peak Summed Discharge:       28.13 CFS at 11:00 on Jan  9 in Year 8
Point of Compliance File:dsout.tsf
```

Flow Duration from Time Series File:rdout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence %	Probability
0.180	40594	66.200	66.200	33.800	0.338E+00
0.535	9446	15.404	81.605	18.395	0.184E+00
0.890	6010	9.801	91.406	8.594	0.859E-01
1.25	2068	3.372	94.778	5.222	0.522E-01
1.60	953	1.554	96.332	3.668	0.367E-01
1.96	589	0.961	97.293	2.707	0.271E-01
2.31	455	0.742	98.035	1.965	0.197E-01
2.67	288	0.470	98.505	1.495	0.150E-01
3.02	195	0.318	98.823	1.177	0.118E-01
3.38	133	0.217	99.039	0.961	0.961E-02
3.73	124	0.202	99.242	0.758	0.758E-02
4.09	63	0.103	99.344	0.656	0.656E-02
4.44	51	0.083	99.428	0.572	0.572E-02
4.80	51	0.083	99.511	0.489	0.489E-02
5.15	42	0.068	99.579	0.421	0.421E-02
5.51	44	0.072	99.651	0.349	0.349E-02
5.86	28	0.046	99.697	0.303	0.303E-02
6.22	33	0.054	99.750	0.250	0.250E-02
6.57	25	0.041	99.791	0.209	0.209E-02
6.93	17	0.028	99.819	0.181	0.181E-02
7.28	15	0.024	99.843	0.157	0.157E-02
7.64	5	0.008	99.852	0.148	0.148E-02
7.99	11	0.018	99.870	0.130	0.130E-02
8.35	16	0.026	99.896	0.104	0.104E-02
8.70	10	0.016	99.912	0.088	0.881E-03
9.06	4	0.007	99.918	0.082	0.815E-03
9.41	4	0.007	99.925	0.075	0.750E-03
9.77	8	0.013	99.938	0.062	0.620E-03
10.12	7	0.011	99.949	0.051	0.506E-03
10.48	8	0.013	99.962	0.038	0.375E-03
10.83	6	0.010	99.972	0.028	0.277E-03
11.19	4	0.007	99.979	0.021	0.212E-03

11.55	2	0.003	99.982	0.018	0.179E-03
11.90	2	0.003	99.985	0.015	0.147E-03
12.26	4	0.007	99.992	0.008	0.815E-04
12.61	4	0.007	99.998	0.002	0.163E-04

Flow Duration from Time Series File:dsout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence %	Probability
0.287	40509	66.062	66.062	33.938	0.339E+00
0.852	9542	15.561	81.623	18.377	0.184E+00
1.42	5477	8.932	90.554	9.446	0.945E-01
1.98	2391	3.899	94.454	5.546	0.555E-01
2.55	1073	1.750	96.204	3.796	0.380E-01
3.11	623	1.016	97.220	2.780	0.278E-01
3.68	489	0.797	98.017	1.983	0.198E-01
4.24	283	0.462	98.478	1.522	0.152E-01
4.81	195	0.318	98.796	1.204	0.120E-01
5.37	155	0.253	99.049	0.951	0.951E-02
5.94	116	0.189	99.238	0.762	0.762E-02
6.50	65	0.106	99.344	0.656	0.656E-02
7.07	54	0.088	99.432	0.568	0.568E-02
7.63	55	0.090	99.522	0.478	0.478E-02
8.20	45	0.073	99.596	0.404	0.404E-02
8.76	45	0.073	99.669	0.331	0.331E-02
9.33	28	0.046	99.715	0.285	0.285E-02
9.89	32	0.052	99.767	0.233	0.233E-02
10.46	27	0.044	99.811	0.189	0.189E-02
11.02	20	0.033	99.843	0.157	0.157E-02
11.59	4	0.007	99.850	0.150	0.150E-02
12.15	8	0.013	99.863	0.137	0.137E-02
12.72	15	0.024	99.887	0.113	0.113E-02
13.28	11	0.018	99.905	0.095	0.946E-03
13.85	6	0.010	99.915	0.085	0.848E-03
14.41	4	0.007	99.922	0.078	0.783E-03
14.98	5	0.008	99.930	0.070	0.701E-03
15.54	8	0.013	99.943	0.057	0.571E-03
16.11	9	0.015	99.958	0.042	0.424E-03
16.67	7	0.011	99.969	0.031	0.310E-03
17.24	5	0.008	99.977	0.023	0.228E-03
17.80	3	0.005	99.982	0.018	0.179E-03
18.37	2	0.003	99.985	0.015	0.147E-03
18.93	2	0.003	99.989	0.011	0.114E-03
19.50	5	0.008	99.997	0.003	0.326E-04
20.06	1	0.002	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: predev.tsf
New File: dsout.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
5.31 |	0.98E-02	0.97E-02	-0.7 |	0.98E-02	5.31	5.30	-0.2
6.55 |	0.66E-02	0.65E-02	-1.7 |	0.66E-02	6.55	6.46	-1.4
7.79 |	0.44E-02	0.46E-02	5.2 |	0.44E-02	7.79	7.90	1.5

9.03	0.29E-02	0.31E-02	6.8	0.29E-02	9.03	9.28	2.8
10.27	0.19E-02	0.20E-02	9.6	0.19E-02	10.27	10.63	3.5
11.51	0.14E-02	0.15E-02	13.3	0.14E-02	11.51	12.20	6.1
12.75	0.98E-03	0.11E-02	13.3	0.98E-03	12.75	13.13	3.0
13.99	0.77E-03	0.82E-03	6.4	0.77E-03	13.99	14.68	5.0
15.23	0.55E-03	0.65E-03	17.6	0.55E-03	15.23	15.61	2.5
16.47	0.38E-03	0.36E-03	-4.3	0.38E-03	16.47	16.31	-0.9
17.71	0.20E-03	0.18E-03	-8.3	0.20E-03	17.71	17.44	-1.5
18.95	0.13E-03	0.11E-03	-12.5	0.13E-03	18.95	18.87	-0.4
20.19	0.49E-04	0.00E+00	-100.0	0.49E-04	20.19	19.45	-3.6
21.43	0.33E-04	0.00E+00	-100.0	0.33E-04	21.43	19.61	-8.5

Maximum positive excursion = 0.775 cfs (6.8%)
occurring at 11.35 cfs on the Base Data:predev.tsf
and at 12.13 cfs on the New Data:dsout.tsf

Maximum negative excursion = 1.86 cfs (-8.7%)
occurring at 21.31 cfs on the Base Data:predev.tsf
and at 19.45 cfs on the New Data:dsout.tsf

Route Time Series through Facility
Inflow Time Series File:rdin.tsf
Outflow Time Series File:rdout
POC Time Series File:dsout

Inflow/Outflow Analysis
Peak Inflow Discharge: 23.14 CFS at 7:00 on Jan 9 in Year 8
Peak Outflow Discharge: 17.10 CFS at 12:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.67 Ft
Peak Reservoir Elev: 3.67 Ft
Peak Reservoir Storage: 252806. Cu-Ft
: 5.804 Ac-Ft

Add Time Series:bypass.tsf
Peak Summed Discharge: 28.13 CFS at 11:00 on Jan 9 in Year 8
Point of Compliance File:dsout.tsf

Flow Duration from Time Series File:rdout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence %	Probability
0.180	40594	66.200	66.200	33.800	0.338E+00
0.535	9446	15.404	81.605	18.395	0.184E+00
0.890	6010	9.801	91.406	8.594	0.859E-01
1.25	2068	3.372	94.778	5.222	0.522E-01
1.60	953	1.554	96.332	3.668	0.367E-01
1.96	589	0.961	97.293	2.707	0.271E-01
2.31	455	0.742	98.035	1.965	0.197E-01
2.67	288	0.470	98.505	1.495	0.150E-01
3.02	195	0.318	98.823	1.177	0.118E-01
3.38	133	0.217	99.039	0.961	0.961E-02
3.73	124	0.202	99.242	0.758	0.758E-02
4.09	63	0.103	99.344	0.656	0.656E-02
4.44	51	0.083	99.428	0.572	0.572E-02

4.80	51	0.083	99.511	0.489	0.489E-02
5.15	42	0.068	99.579	0.421	0.421E-02
5.51	44	0.072	99.651	0.349	0.349E-02
5.86	28	0.046	99.697	0.303	0.303E-02
6.22	33	0.054	99.750	0.250	0.250E-02
6.57	25	0.041	99.791	0.209	0.209E-02
6.93	17	0.028	99.819	0.181	0.181E-02
7.28	15	0.024	99.843	0.157	0.157E-02
7.64	5	0.008	99.852	0.148	0.148E-02
7.99	11	0.018	99.870	0.130	0.130E-02
8.35	16	0.026	99.896	0.104	0.104E-02
8.70	10	0.016	99.912	0.088	0.881E-03
9.06	4	0.007	99.918	0.082	0.815E-03
9.41	4	0.007	99.925	0.075	0.750E-03
9.77	8	0.013	99.938	0.062	0.620E-03
10.12	7	0.011	99.949	0.051	0.506E-03
10.48	8	0.013	99.962	0.038	0.375E-03
10.83	6	0.010	99.972	0.028	0.277E-03
11.19	4	0.007	99.979	0.021	0.212E-03
11.55	2	0.003	99.982	0.018	0.179E-03
11.90	2	0.003	99.985	0.015	0.147E-03
12.26	4	0.007	99.992	0.008	0.815E-04
12.61	4	0.007	99.998	0.002	0.163E-04

Flow Duration from Time Series File:dsout.tsf

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1.42	5477	8.932	90.554	9.446	0.945E-01
1.98	2391	3.899	94.454	5.546	0.555E-01
2.55	1073	1.750	96.204	3.796	0.380E-01
3.11	623	1.016	97.220	2.780	0.278E-01
3.68	489	0.797	98.017	1.983	0.198E-01
4.24	283	0.462	98.478	1.522	0.152E-01
4.81	195	0.318	98.796	1.204	0.120E-01
5.37	155	0.253	99.049	0.951	0.951E-02
5.94	116	0.189	99.238	0.762	0.762E-02
6.50	65	0.106	99.344	0.656	0.656E-02
7.07	54	0.088	99.432	0.568	0.568E-02
7.63	55	0.090	99.522	0.478	0.478E-02
8.20	45	0.073	99.596	0.404	0.404E-02
8.76	45	0.073	99.669	0.331	0.331E-02
9.33	28	0.046	99.715	0.285	0.285E-02
9.89	32	0.052	99.767	0.233	0.233E-02
10.46	27	0.044	99.811	0.189	0.189E-02
11.02	20	0.033	99.843	0.157	0.157E-02
11.59	4	0.007	99.850	0.150	0.150E-02
12.15	8	0.013	99.863	0.137	0.137E-02
12.72	15	0.024	99.887	0.113	0.113E-02
13.28	11	0.018	99.905	0.095	0.946E-03
13.85	6	0.010	99.915	0.085	0.848E-03
14.41	4	0.007	99.922	0.078	0.783E-03
14.98	5	0.008	99.930	0.070	0.701E-03

15.54	8	0.013	99.943	0.057	0.571E-03
16.11	9	0.015	99.958	0.042	0.424E-03
16.67	7	0.011	99.969	0.031	0.310E-03
17.24	5	0.008	99.977	0.023	0.228E-03
17.80	3	0.005	99.982	0.018	0.179E-03
18.37	2	0.003	99.985	0.015	0.147E-03
18.93	2	0.003	99.989	0.011	0.114E-03
19.50	5	0.008	99.997	0.003	0.326E-04
20.06	1	0.002	99.998	0.002	0.163E-04

EXHIBIT S1

KCTRS Basin Input Data:

Existing Conditons

Basin	Till Area (Ac) Impervious	Grass	Forest	Pasture	
A	0.95	14.3	49.59		
B	0		21		
F	1.2	1.5	11.5		
E			41.75		
H	1.29			73.88	
Total	3.44	15.8	123.84	74	216.96

Developed Conditons

Basin	Till Area (Ac) Impervious	Grass	Impervious	Pasture	
A	5.95	7.35	51.5		
B	3.89	3.8	13.31		
F	1.2	1.5	11.5		
E			41.75		
SubTotals	**11.04**	**12.65**	**188.06**	0	
H-Bypass	1.95			73.22	
Total	12.99	12.65	118.06	73	216.92

EXHIBIT S2

Wet Pond Volume Data

Elev	Stage	Contour Area (sf) west pond	east pond	Pond Total Contours	Incremental Storage (cf)	Total Storage (cf)		
74	0	0	11,039	11,039	0	0		
75	1		13,038	13,038	12,039	12,039		
76	2							
77	3		17,328	17,328	30,366	42,405		
78	4							
79	5							
80	6							
81	7							
81.5	**7.5**	**30,775**	**29,198**	**59,973**	**173,927**	216,332	**wet pond requirments satisfied**	
82	8							
83	9							
84	10							
85	11	38,707	38,840	77,547	240,660	456,992	**det vol provided=**	**240,660**
86	12							
87	13							

Assume only east pond will have an overflow structure, use 48" min. standpipe to accomadate enlarged bypass orifice

EXHIBIT S3

Volume Displaced by East Pond

Assumed 100 yr Flood Elev	Elev Range (ft)	Existing Terrian Average Elev (ft)	Surface Area (sf)	Average Displaced Depth (ft)	Displaced Vol (cf) per Elevation	
82	82-80	81	10804	1	10,804	
82	80-78	79	6965	3	20,895	
82	78-76	77	3242	5	16,210	
82	76-74	75	3100	7	21,700	
82	74-72	73	3100	9	25,535	
					95,144	= Total Dispaced Vol (cf)

EXHIBIT S4

Resizing the KCTRS Detention Orifices to Bypass Offsite Flow through the Pond

Orifice #	Detention Orifice Stage (ft)	Detention Orifice Size (in)
1	0	6
2	0.5	16

*For Level 2 facility objective is to match 50% of the predev 2 yr & equal to the 50 yr flows

Calculated Peak Pond Stage (ft) = 3.67

Top of Riser (ft) = 3.5

EXHIBIT S5

Weir Section for Emergency Overflow Spillway Design (KCSWDM p 5-32)

Spillway Bottom Elev (ft)=	85.17	(the KCRTS detention overflow WS)
Total 100-yr developed flow (On- & Off-Site) (cfs) =	23.14	
Emergency Overflow WS (ft) =	85.17	
Required Top of Berm <0.3' minimum freeboard above Emer WS> ft =	85.47	
Provided Top of Berm Elev (ft) =	87	

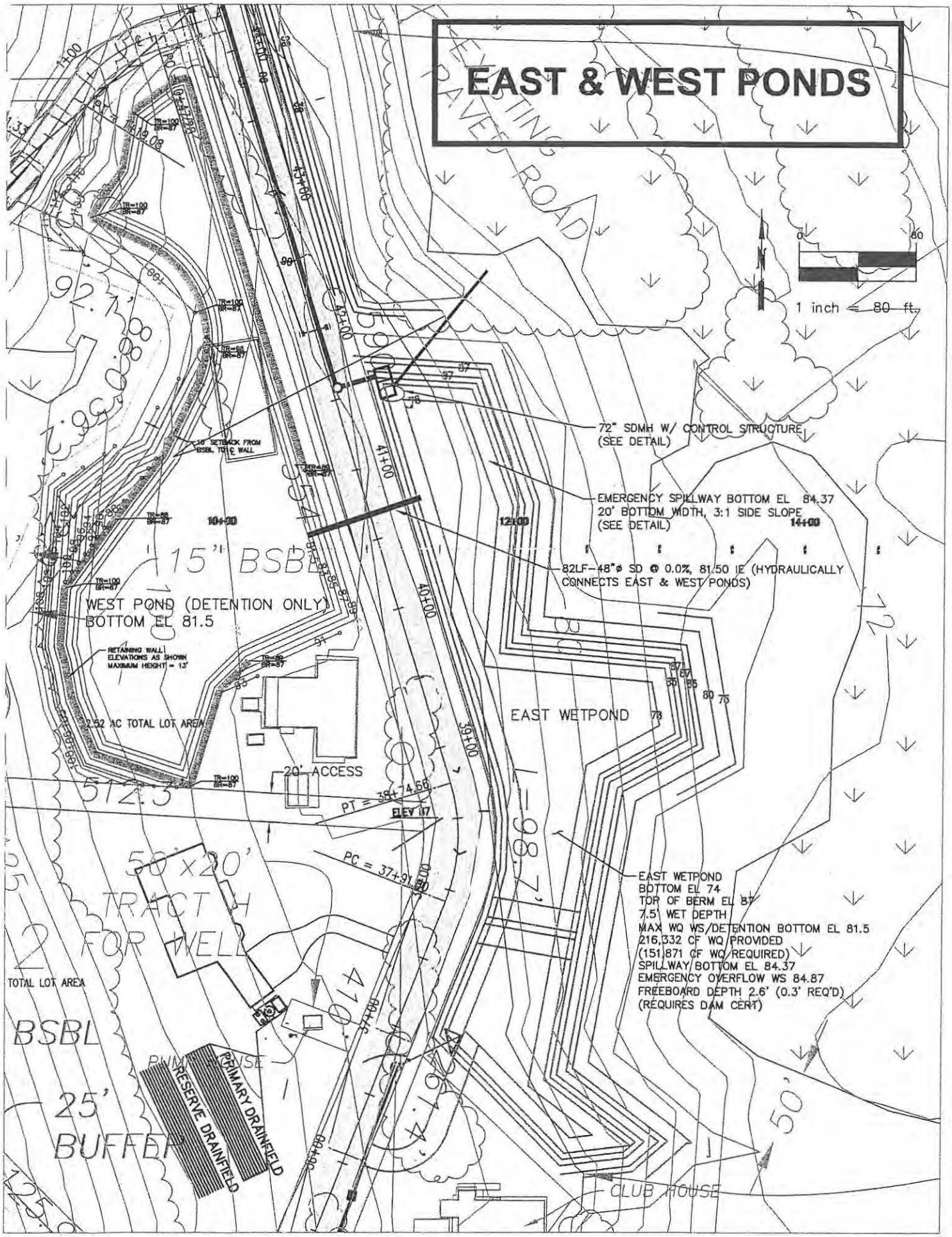
Q100 =	**23.14**	cfs
Z = Sideslope =	3	ft/ft
G = Gravity =	32.2	ft/s^2

Emergency Overflow Spillway

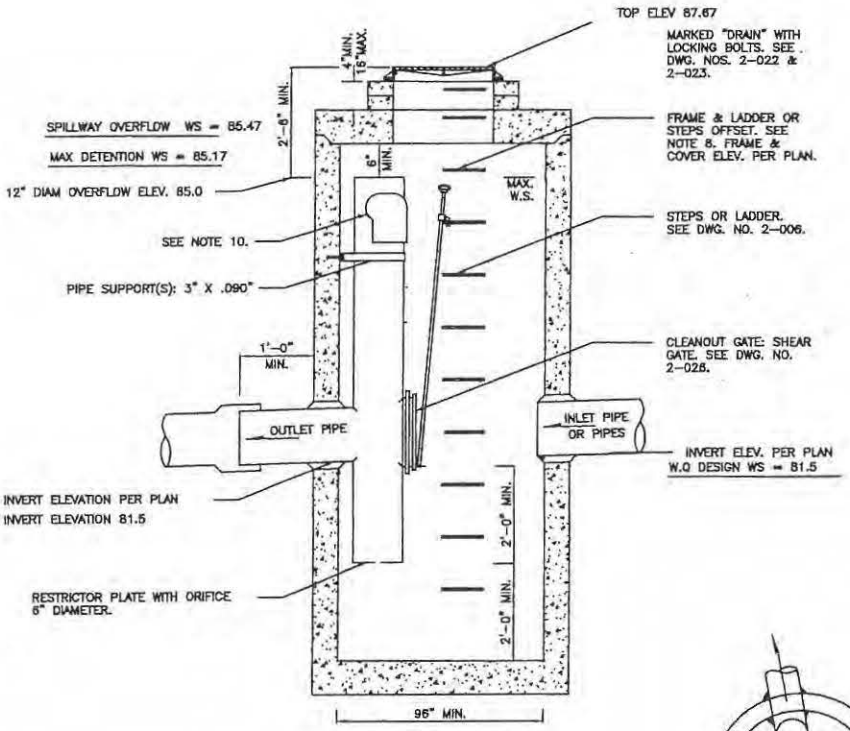
ho = Overflow depth =	0.5	ft
Lo = Bottom width =	(Q100/(3.21*ho^1.5)) - 2.4*ho	
	19.2 ft, **USE**	**20.0 FT**

Provide: 3.6" min. freeboard; 6.0' min. bottom width

EAST & WEST PONDS

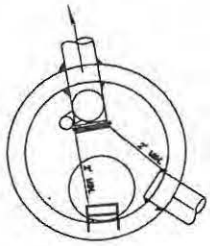


POND CONTROL STRUCTURE & SPILLWAY DETAILS 2-17-11



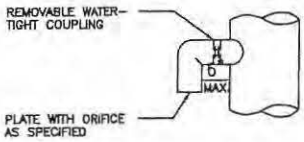
CATCH BASIN TYPE 2
DIAM. AS REQUIRED
SEE DWG. NO. 2-005.

NOTES:
1. PIPE SIZES AND SLOPES: PER PLANS.
2. OUTLET CAPACITY: NOT LESS THAN COMBINED INLETS.
3. EXCEPT AS SHOWN OR NOTED, UNITS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FOR CATCH BASIN TYPE 2, 54" MIN. DIAM.
4. PIPE SUPPORTS AND RESTRICTOR/SEPARATOR SHALL BE OF SAME MATERIAL, AND BE ANCHORED AT 3' MAX. SPACING BY 5/8" DIAM. STAINLESS STEEL EXPANSION BOLTS OR EMBEDDED 2" IN WALL.
5. THE RESTRICTOR/SEPARATOR SHALL BE FABRICTED FROM .060" ALUMINUM, OR .064" ALUMINIZED STEEL, OR .064" GALVANIZED STEEL PIPE; IN ACCORDANCE WITH AASHTO M 36, M 196, M 197 AND M 274. GALVANIZED STEEL SHALL HAVE TREATMENT 1.
6. OUTLET SHALL BE CONNECTED TO CULVERT OR SEWER PIPE WITH A STANDARD COUPLING BAND FOR CORRUGATED METAL PIPE, OR GROUTED INTO THE BELL OF CONCRETE PIPE.
7. THE VERTICAL RISER STEM OF THE RESTICTOR/SEPARATOR SHALL BE THE SAME DIAM. AS THE HORIZONTAL OUTLET PIPE, WITH AN 8" MIN. DIAM.
8. FRAME AND LADDER OR STEPS OFFSET SO THAT: A. CLEANOUT GATE IS VISIBLE FROM TOP. B. CLIMB DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE. C. FRAME IS CLEAR OF CURB.
9. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE: OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4".
10. MULTI-ORIFICE ELBOWS MAY BE LOCATED AS SHOWN OR ALL ON ONE SIDE OF RISER TO ASSURE LADDER CLEARANCE.
ORFICE # 1 (BOTTOM) ø= 6 IN.
ORFICE # 2 (TOP) ø= 16 IN. ELEV = 83.5.5



PLAN

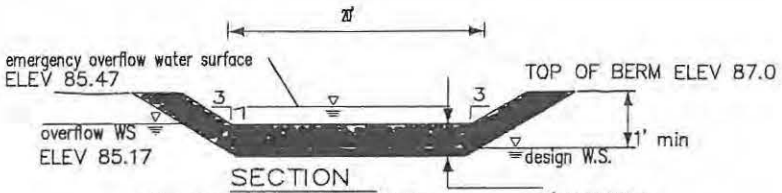
CONTROL MH DATA	EAST POND
CATCH BASIN DIAM	96"
TOP ELEV	ELEV 87.67
RISER DIAMETER	48"
RISER ELEV	ELEV 85.17
OUTLET DIAM	24"
OUTLET INV	81.5
ORFICE #1 DIAM	6"
ORF #2 DIAM	16"
ORFICE #2 ELEV	83.5



ELBOW DETAIL

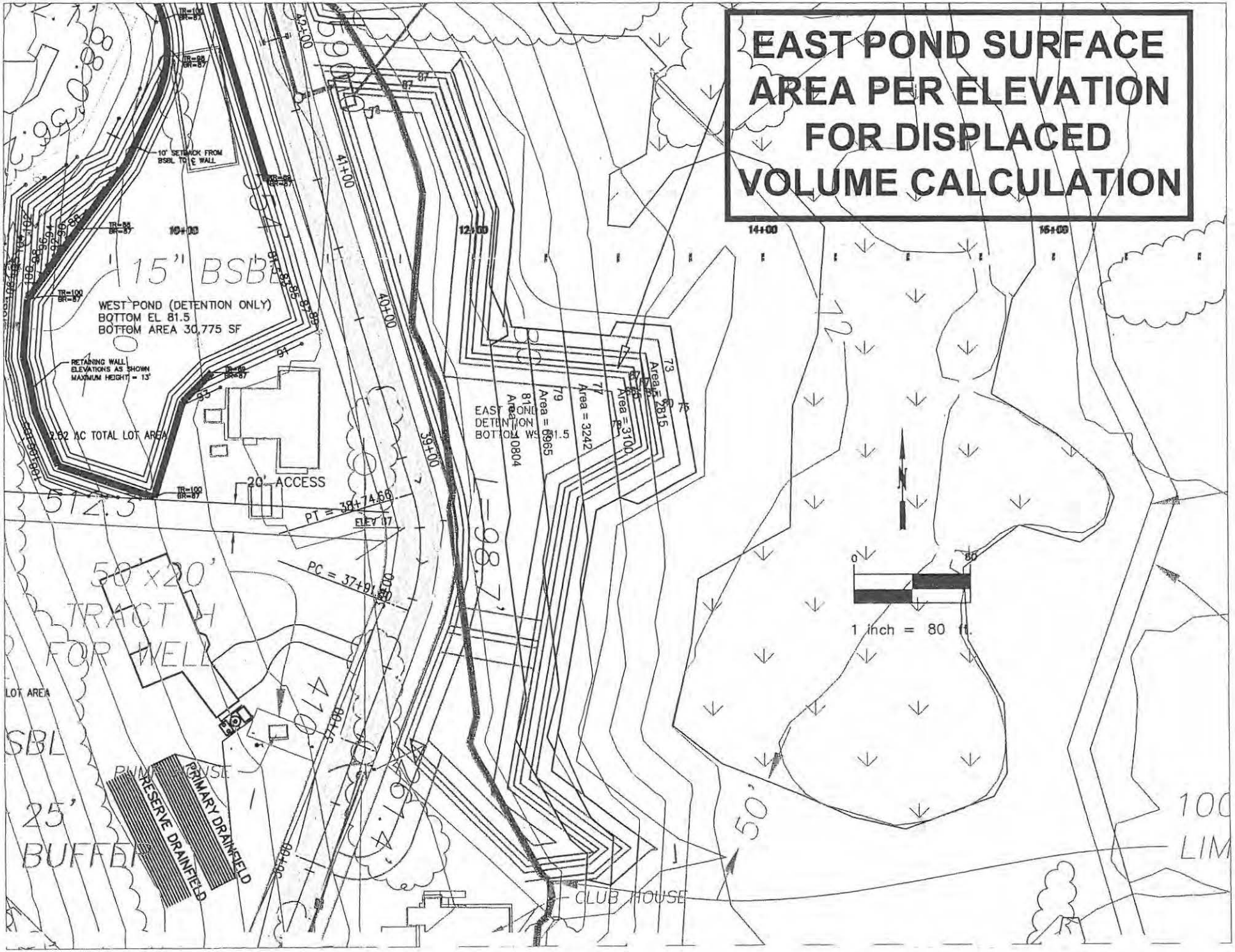
FLOW RESTRICTOR / OIL POLLUTION CONTROL DEVICE, TEE TYPE (FROP-T)

2-025



SECTION
Emergency Overflow Spillway
NTS

EAST POND SURFACE AREA PER ELEVATION FOR DISPLACED VOLUME CALCULATION



TALL CHIEF | 2-17-11

EL	STAGE	W POND CONTOUR AREA	E POND CONTOUR AREA	TOTAL CONTOURS	INCREMENTAL VOLUME	TOTAL VOL
87		43420	44528			
86						
85.2	3.7	39178	39408	78586	15613.2	256640
85	3.5	38707	38839	77546	20971	241047
84						
83.5						
83				70101.0		
82		31908	30765	62673	31,336	31336
81.5	0	30775	29420	60,195	0	0
81						
80						
79						
78			20,002			
77						
76						
75						
74			8348			

2-17-11 TAW-CHIEF

cutoffs = 17

2 yr Pnadw - 10.69 CFS

50 yr Pnadw - 30.19

25 yr " - 21.46

100 yr - 34.55

- 50% of 2 yr flow = 10.69 x 50% = 5.345

- INTERVAL SIZE = $\frac{50\text{yr} - (50\% \text{ of } 2\text{yr})}{\text{COT Dis} - 1} = \frac{30.19 - 5.345}{16} = 1.55$

Pond

2:1

L/W RATIO - 2

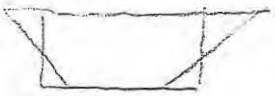
STORAGE Depth = 85 - 81.5 = 3.5 FT

- HEIGHT OF ORIFICE #2 = 3/4 STORAGE Depth = 3/4 x 3.5 = 2.62

- QMAX = 4/3 x 2 yr Target (pnadw) = 4/3 x 10.69 = 14.25

Flowth - 31 000 CF STORAGE VOLUME - WOWT PASS WAYNE

OLD POND - 240,460 CF STORAGE - 3.5' Depth = 68,760 SF AVE



= 262 X 262 FT.

Bottom cutoff = 50% of 2 yr Pnadw = 10.69 x 50% = ~~5.3445~~ 5.345

Upper cutoff = use Bottom

KCRTS Computer Model Run for Tall Chief Detention

```
                    KCRTS Command
                    -------------
              CREATE a new Time Series for Total On-Site Flow
              -----------------------
            Production of Runoff Time Series
   Project Location : Landsburg
    Computing Series : predev.tsf   BASIN A & B
Regional Scale Factor :    1.00
          Data Type : Reduced
Creating Hourly Time Series File
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60R.rnf   :
Till Forest            70.59 acres
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60R.rnf   :
Till Grass             14.30 acres
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf   :
Impervious              0.95 acres
             --------------
        Total Area :   85.84 acres
Peak Discharge:  13.09 CFS at  7:00 on Jan  9 in Year 8
                          Storing Time Series File:predev.tsf   :
                Time Series Computed

                    KCRTS Command
                    -------------
              CREATE a new Time Series
              -----------------------
            Production of Runoff Time Series
   Project Location : Landsburg
    Computing Series : dev.tsf   BASIN A & B
Regional Scale Factor :    1.00
          Data Type : Reduced
Creating Hourly Time Series File
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60R.rnf   :
Till Forest            64.79 acres
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60R.rnf   :
Till Grass             11.15 acres
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf   :
Impervious              9.84 acres
             --------------
        Total Area :   85.78 acres
Peak Discharge:  16.17 CFS at  7:00 on Jan  9 in Year 8
                          Storing Time Series File:dev.tsf   :
                Time Series Computed

                    KCRTS Command
                    -------------
            Enter the Analysis TOOLS Module
            -------------------------------

                Analysis Tools Command
                ----------------------
          Compute PEAKS and Flow Frequencies
          ----------------------------------
                     Loading Stage/Discharge curve:dev.tsf   :
      Flow Frequency Analysis
      -------------------------------------------------------
  Time Series File:dev.tsf
  Project Location:Landsburg
                      Frequencies & Peaks saved to File:dev.pks   :

                Analysis Tools Command
                ----------------------
          Compute PEAKS and Flow Frequencies
          ----------------------------------
                     Loading Time Series File:predev.tsf   :
      Flow Frequency Analysis
      -------------------------------------------------------
  Time Series File:predev.tsf
  Project Location:Landsburg
                      Frequencies & Peaks saved to File:predev.pks   :
```

Analysis Tools Command

RETURN to Previous Menu

KCRTS Command
---
eXit KCRTS Program

Flow Frequency Analysis
Time Series File:**predev**.tsf
Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
8.42	2	2/09/01 15:00	13.09	1	100.00	0.990
1.90	8	1/05/02 16:00	8.42	2	25.00	0.960
5.66	4	2/28/03 16:00	7.27	3	10.00	0.900
1.96	7	8/26/04 1:00	5.66	4	5.00	0.800
5.15	5	1/05/05 10:00	5.15	5	3.00	0.667
4.10	6	1/18/06 21:00	4.10	6	2.00	0.500
7.27	3	11/24/06 5:00	1.96	7	1.30	0.231
13.09	1	1/09/08 7:00	1.90	8	1.10	0.091
Computed Peaks			11.53		50.00	0.980

Flow Frequency Analysis
Time Series File:**dev**.tsf
Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
9.64	2	2/09/01 14:00	16.18	1	100.00	0.990 ← 100 YR ONSITE
3.21	8	1/05/02 16:00	9.64	2	25.00	0.960
6.90	4	2/28/03 16:00	9.45	3	10.00	0.900
5.37	6	8/26/04 1:00	6.90	4	5.00	0.800
6.35	5	1/05/05 10:00	6.35	5	3.00	0.667
5.23	7	1/18/06 16:00	5.37	6	2.00	0.500
9.45	3	11/21/06 9:00	5.23	7	1.30	0.231
16.18	1	1/09/08 7:00	3.21	8	1.10	0.091
Computed Peaks			14.00		50.00	0.980

Determine Cutoff Interval:

Intial sizing of pond is 346,000 cf

```
                                KCRTS Command
                              -------------
                    CREATE a new Time Series for Total Off-Site Flow
                    ------------------------
                  Production of Runoff Time Series
    Project Location : Landsburg
     Computing Series : offsite.tsf   BASIN E & F
Regional Scale Factor :    1.00
            Data Type : Reduced
Creating Hourly Time Series File
                 Loading Time Series File:C:\KC_SWDM\KC_DATA\LATF60R.rnf    :

Till Forest          53.25 acres
                 Loading Time Series File:C:\KC_SWDM\KC_DATA\LATG60R.rnf    :
Till Grass            1.50 acres
                 Loading Time Series File:C:\KC_SWDM\KC_DATA\LAEI60R.rnf    :
Impervious            1.20 acres
                 --------------
        Total Area :   55.95 acres
Peak Discharge:   6.97 CFS at  7:00 on Jan  9 in Year 8
                                   Storing Time Series File:offsite.tsf    :
                        Time Series Computed

                              KCRTS Command
                              -------------
                     Enter the Analysis TOOLS Module
                     -------------------------------

                         Analysis Tools Command
                         ----------------------
                   Compute PEAKS and Flow Frequencies
                   ----------------------------------
                            Loading Stage/Discharge curve:offsite.tsf    :
        Flow Frequency Analysis
        -------------------------------------------------------
 Time Series File:offsite.tsf
 Project Location:Landsburg
                          Frequencies & Peaks saved to File:offsite.pks    :

                         Analysis Tools Command
                         ----------------------
                         RETURN to Previous Menu
                         -----------------------
                              KCRTS Command
                              -------------
                           eXit KCRTS Program
                           ------------------
        Flow Frequency Analysis
 Time Series File:offsite.tsf
 Project Location:Landsburg
```

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
5.32	2	2/09/01 18:00	6.97	1	100.00	0.990 ← 100 yr OFFSITE
1.08	7	1/05/02 16:00	5.32	2	25.00	0.960
3.51	4	2/28/03 16:00	4.49	3	10.00	0.900
0.690	8	3/03/04 2:00	3.51	4	5.00	0.800
3.22	5	1/05/05 10:00	3.22	5	3.00	0.667
2.59	6	1/18/06 21:00	2.59	6	2.00	0.500
4.49	3	11/24/06 5:00	1.08	7	1.30	0.231
6.97	1	1/09/08 7:00	0.690	8	1.10	0.091
Computed Peaks			6.42		50.00	0.980

TALL CHIEF | 1/9/08 HEH
REVISED 7/15/09 *

FLOODPLAIN FILL ASSESSMENT + COMPENSATING EXCAVATION

— (TALL CHIEF ROAD)
ENTRY ROAD - FROM STATION 47+00 TO 62+50 (END)

TAKEN FROM CADD GENERATED VOLUMES & SECTIONS - SEE PLANS. SHEET 9-4

	CUMULATIVE CUT	CUMULATIVE FILL
STATION 46+00	14012.64 CY	6567.26 CY
STATION 62+50	14603.39	7314.43
DELTA Δ	591 CY CUT	747 CY. FILL

THEREFORE, TOTAL ENTRY ROAD REQD. FLOODPLAIN COMP = 747-591 = 156 CY.

— WETPOND - SEE EXHIBIT S3 FOR DISPLACED VOLUME GRAPHIC SOLUTION.

VOLUME = 95,000 CF = 3,518 CY

TOTAL COMPENSATING VOL REQD = 156 CY + 3,518 CY = 3,674 CY
= 99,198 CF

☆ - MITIGATION PROVIDED NEAR TALL CHIEF ROAD STATION 42+00 TO 47+00

MITIGATION AREA = 24,461 SF, AVE DEPTH = 4.1', RANGE EL 78 TO 82+

COMPENSATING VOLUME = 24,461 SF X 4.1 = 100,290 CF ✓ OK

TALL CHIEF | 2-17-11

BASIC FILTER STRIP. - 98 KCSWM Pg 6-57

TALL CHIEF - ENTRY ROAD STA 0+00 TO 13+50 AND SNOQ. RIVER ROAD

AREAS

TALL CHIEF ROAD - 1/2 ST = 14'W

L = 0+00 TO 13+50 AREA = 1350 X 14 = 18,900 SF = 0.434 AC

SNOQ. RIVER ROAD - 1/2 ST = 15'W

L = 2353 AREA = 2353 X 15 = 35,295 SF = 0.810 AC

TOTAL = 1.24 AC

Q_{wq} = 24 HOUR STORM = 0.866 CFS

$$df = \left(\frac{Q_{wq}\, n_{wq}}{1.49\, W\, S^{0.5}}\right)^{0.6}$$

$n_{wq} = 0.35$

$W = 2353 + 1350 = 3703$ FT

$S = 5\%$ AVE $= 0.05$ FT/FT

$$df = \left(\frac{0.866 \times 0.35}{1.49 \times 3703 \times 0.05^{1/2}}\right)^{0.6} = 0.00683$$

$$V_{wq} = \frac{Q_{wq}}{W \times df} = \frac{0.866}{3703 \times 0.00683} = 0.0342$$

$L = 540\, V_{wq} = 540 \times 0.0342 = 18.5'$ - USE 20' filter strip.

```
                    Version 6.00
All files will be read/written in the Working Directory
Working Directory:C:\kc_swdm\output
------------------------------------------------------------
                    KCRTS Command

                    CREATE a new Time Series


              Production of Runoff Time Series
   Project Location : Landsburg
    Computing Series : roadfilter.tsf
Regional Scale Factor :   1.00
         Data Type : Reduced
Creating 15-minute Time Series File
            Loading Time Series File:C:\KC_SWDM\KC_DATA\LAFI15R.rnf   8
Impervious        1.24 acres            Scaling Yr: 8

      Total Area :   1.24 acres
Peak Discharge:  1.86 CFS at  7:30 on Jan  9 in Year 8
                        Storing Time Series File:roadfilter.tsf   8

                    Time Series Computed
------------------------------------------------------------
                    KCRTS Command

                    Enter the Analysis TOOLS Module

------------------------------------------------------------
                    Analysis Tools Command

                    Compute PEAKS and Flow Frequencies

                        Loading Stage/Discharge curve:roadfilter.tsf   :
      Flow Frequency Analysis

 Time Series File:roadfilter.tsf
 Project Location:Landsburg
                        Frequencies & Peaks saved to File:roadfilter.pks   :
```

Help/Files - KCRTS

Time Series File:roadfilter.tsf
Project Location:Landsburg

—Annual Peak Flow Rates—			—Flow Frequency Analysis—			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.672	7	10/04/00 20:15	1.86	1	100.00	0.990
0.662	8	5/06/02 7:15	1.39	2	25.00	0.960
1.39	2	9/10/03 13:45	1.31	3	10.00	0.900
1.11	4	8/25/04 23:30	1.11	4	5.00	0.800
0.872	5	9/10/05 16:45	0.872	5	3.00	0.667
1.31	3	10/22/05 16:15	0.866	6	2.00	0.500
0.866	6	11/21/06 8:00	0.672	7	1.30	0.231
1.86	1	1/09/08 7:30	0.662	8	1.10	0.091
Computed Peaks			1.70		50.00	0.980

start Inbox - Micr... AutoCAD 20... dwg Prelim TIR-Al... KCRTS Help/Files... KCRTS And... 4:39 PM

V. CONVEYANCE SYSTEMS ANALYSIS AND DESIGN

Given the variety of slopes and areas involved in the project, pipe and ditch sizing is beyond the scope of this preliminary report. Final Construction Documents and Final TIR will provide detailed hydraulic analysis.

VI. EROSION/SEDIMENTATION CONTROL DESIGN

Erosion Control Designs (ESC) will be prepared per the County's KCSWM, since the new site impervious area exceeds 5,000 s.f. The plan, together with the grading/drainage plan, will show all existing and proposed topographic features, ESC notes, ESC details and drainage features.

Erosion Control elements will likely consist of Clearing and Grading Limits, Rock Construction Entrance, Silt Fencing and sediment traps and/or ponds.

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