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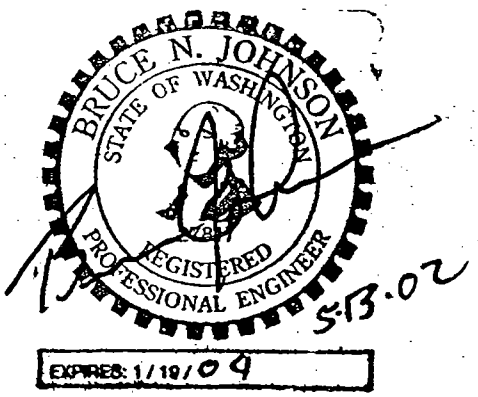
ISSAQUAH HIGHLANDS
SE RURAL DEVELOPMENT AREA

Second Amendment to the Three Party Agreement
Clearing Rights Transfer Mitigation Analysis

Port Blakely Communities
1775 12th Ave NW
Issaquah, WA 98027



Bruce Johnson, P.E.
Job No. 21247
May, 2002

Port Blakely Communities
SE Rural Development Area
Requested Amendments to the Three Party Agreement (TPA)

Request - Transfer 14 acres of clearing rights from a nearby 40 acre parcel to the SE Rural development area. Dedicate the 40 acre parcel to King County as permanent open space.

Why - Provide flexibility for siting houses on lots, many of which are constrained by adjacent sensitive areas, and all of which must accommodate septic drainfields.

Discussion - The TPA limits clearing to 35% of the 150 acre development area, or 52.5 acres. The Issaquah Creek Basin Plan limits clearing to 35% of the area of a development proposal. The clearing rights transfer will increase the allowable clearing within the SE Rural development area to 66.5 acres. Considering both the SE Rural development area and 40 acre parcel together, the 35% limit is maintained.

In a broader perspective, Pt Blakely will dedicate 180 acres of land surrounding the SE Rural development area to King County as permanent open space. The requested 66.5 acres of clearing represents only 18% of the three areas combined.

Request - Increase the allowable impervious coverage from 10.2 to 12 acres.

Why - Address inconsistencies within the TPA and compensate for a significant underestimation of the amount of impervious surface necessary for roads in the TPA.

Discussion - Impervious surface is limited to 8.25 acres in Appendix K to the TPA, and 10.2 acres in Appendix D. Four acres of impervious surface are necessary for roads. This leaves only 4,630 square feet (App K) or 6,750 square feet (App D) available for roofs and driveways. Lots average about 3 acres in size. A driveway can easily require 3,000 square feet of impervious surface to reach the house, leaving very little for the house itself.

Request - Allow the option for reforestation of up to 7 acres of slopes adjacent to roads and ponds. Areas so restored would not count against total clearing.

Why - Restoration will accelerate return of these areas to a natural state, and allow additional lot clearing.

Discussion - Reforestation of areas graded for construction of roads and ponds will be done with native vegetation and amended soils as described below, and will provide the added benefits of reduced runoff, more effective slope stabilization, and enhanced aesthetics.

Mitigation - Port Blakely proposes to:

1. Increase detention volume as necessary to accommodate the additional impervious surface and clearing.

2. Require all impervious surface on lots to meet requirements for "Large Lot Low Impervious Projects" as detailed in the Draft Update to the 1998 King County Surface Water Design Manual. These requirements are primarily flow dispersion that directs runoff back into the native landscape.

3. Require all lots to use a minimum of 8 inches of amended soil for all cleared areas (except drainfields), in order to approximate the water-holding characteristics of the disturbed or removed native soils.

Analysis has shown the combined mitigations fully address hydrologic impacts of the additional clearing and impervious surface, and will result in a developed site that meets the intent of both Appendix D to the TPA and the Issaquah Creek Basin Plan.

Detention ponds will function in excess of the highest performance standard currently required. Durations of erosive levels of runoff leaving the developed site will closely match durations of erosive runoff from the undeveloped site. Use of detention, flow dispersion and amended soils as proposed also minimizes unavoidable increases in runoff volumes due to site development.

Introduction

Port Blakely Communities has proposed to transfer clearing rights from a nearby parcel adjacent to the Grand Ridge open space (the "Open Space parcel") to the SE Rural development area. The 40 acre Open Space parcel would be dedicated to King County as permanent open space, with the allowable clearing area established by the Issaquah Creek Basin Plan (35%, or 14 acres) transferred to the SE Rural development area. The resulting cleared area of the SE Rural development area, however, would be in excess of that provided for in previous development agreements. This analysis considers mitigations for hydrologic impacts of the additional clearing.

The SE Rural development area totals 330 acres, of which 180 acres will be set aside as permanent open space, leaving 150 acres for development. Of the 150 acres, approximately 46 acres would be set aside as privately owned open space tracts, and 104 acres divided into roads, stormwater facilities and 40 lots. Lots average about 3 acres. The developed area is tributary to several creeks that ultimately drain to East Fork Issaquah Creek.

The Open Space Parcel is a quarter section (40 acres) located directly north of the SE Rural development area and just outside the Issaquah Highlands boundary. Runoff flows to North Fork Issaquah Creek.

Conditions of the Three Party Agreement

The June 10, 1996 Three Party Agreement (TPA) between King County, the City of Issaquah and the Grand/Glacier Ridge partnerships, sets development standards for Issaquah Highlands, including the SE Rural development area. Clearing and impervious surface limits are variously established in Section 4.3.6.4 of the executed TPA, Appendix D to the TPA (Development Standards - Stormwater Management and Groundwater Protection), and Appendix K to the TPA (Rural Area Land Uses and Density). Table 1 below lists both limits established in the TPA and those requested in the Amendment.

	Section 4.3.6.4, TPA	Appendix D Stormwater Standards	Appendix K Rural Area - Land Uses/Density	40 ac add'nl Open Space to King Co.	Requested, Amend. No. 2
Allowable impervious	---	10.2 ac (6.8% of 150 ac)	8.25 ac (5.5% of 150 ac)	---	12.0 ac (8% of 150 ac)
Allowable landscaping	---	---	44.25 ac (29.5% of 150 ac)	---	54.5 ac (36% of 150 ac)
Total clearing	52.5 ac (35% of 150 ac, 16% of 330 ac)	---	52.5 ac (35% of 150 ac, 16% of 330 ac)	14 ac (35% of 40 ac)	66.5 ac (44% of 150 ac, 20% of 330 ac)

Table 1. Allowable Impervious Coverage and Clearing

A second amendment to the TPA is proposed to address inconsistencies within the TPA regarding the allowable impervious surface and also to allow the transfer of clearing rights from the Open Space parcel to the SE Rural development area. Also proposed is a request to allow Pt Blakely the option of restoring cleared areas adjacent to roads and stormwater ponds. The area reforested could then be applied to lot clearing.

The proposed second amendment would add 1.2 acres of impervious surface and 14 acres of clearing to the SE Rural development area. The request for additional impervious surface is necessitated by a significant underestimation in the original TPA of the amount impervious surface necessary for roads. Additional clearing will provide flexibility for siting houses on the lots, many of which are constrained by adjacent sensitive areas, and all of which must accommodate a septic drainfield.

Elements of the Proposal

Table 2 below summarizes the distribution of impervious surface and cleared areas both in the current engineering plans and with approval of Amendment No. 2.

	Total clearing (ac)	Pond, road clearing (ac)	Lot clearing (ac)	Clearing / lot (sf)	Total imp (ac)	Road imp (ac)	Imp/lot (sf)	Lndscp /lot (sf)[1]	Amended soil area / lot (sf)[2]
Current Eng Plans	52.5	18.6	33.9	36,900	10.2	4	6,750	30,150	----
Reforest 7 ac (optional)[3]	52.5	11.6	40.9	44,540	12	4	8,700	35,840	----
Transfer 14 ac	66.5	18.6	47.9	52,160	12	4	8,700	43,460	34,460
Reforest 7 ac & transfer 14 ac	66.5	11.6	54.9	59,780	12	4	8,700	51,080	42,080

Table 2 – Distribution of Clearing and Impervious Surface

1. Landscaping/lot = clearing/lot – imp/lot; includes drainfield
2. Amended soil area/lot = clearing/lot – impervious/lot – 9000 sf (primary drainfield)
3. see reforestation requirements described on p. 3

Current Engineering Plans - SE Rural engineering plans have been under development and review for several years. The plans currently comply with the 35% total clearing limit imposed by the TPA and the Issaquah Creek Basin Plan, and the 10.2 acre total impervious surface coverage set by Appendix D. Table 3 lists the distribution and disposition of runoff from impervious surface and cleared areas as shown in the current engineering plans and those requested in the amendment.

Current Engineering Plans		Per Amendment No. 2	
To ponds	Dispersed	To ponds	Dispersed
4.0 ac roads 3.1 ac roofs, driveways 18.2 ac landscaping (25.30 ac cleared)	3.1 ac roofs, driveways 24.1 ac landscaping (27.2 ac cleared)	4.0 ac roads 3.6 ac roofs, driveways 24.0 ac landscaping (31.6 ac cleared)	4.4 ac roofs, driveways 30.5 ac landscaping (34.9 ac cleared)
52.5 ac cleared, 10.2 ac impervious		66.5 ac cleared, 12 ac impervious	

Table 3 - Landcover Comparisons

Under both scenarios, all roadway runoff would be directed to ponds for detention and water quality treatment, along with roofs, driveways and landscaping from 18 of the 40 lots. Developed runoff from the remaining 22 lots cannot be conveyed to any of the six stormwater facilities because the lots are unavoidably located below the roadway conveyance system and ponds.

Dispersion of Lot Runoff - The current engineering plans identify those lots not draining to ponds and notes that these lots must be submitted for drainage review at the time of building permit application (this condition would also be included in the short plat documents). The lots would be considered stand-alone development proposals and comply with King County Small Sites drainage requirements (or their future equivalent), or provide formal flow control/water quality facilities, if applicable clearing/impervious surface thresholds are exceeded.

While the hydrologic requirements listed in Appendix D to the TPA did not necessarily anticipate this many lots unable to discharge to formal stormwater facilities, application of Small Sites BMPs or stand-alone detention/water quality facilities will still provide the level of protection and treatment required in both the TPA and basin plan. Dispersion has increasingly become the preferred method for disposition of runoff from large lots with relatively low impervious coverages and high native vegetation retention, as illustrated in the March 2002 draft update to the 1998 King County Surface Water Design Manual (SWDM).

The benefits of dispersing runoff to adjacent unconverted areas are well documented, including peak attenuation and storage provided by the upper soil horizons of loam and forest duff, reduced peaks and volumes at pond discharge points (which are by necessity at streams or ravines that are or can become erosion sensitive), groundwater recharge and summer stream baseflow maintenance.

Reforestation Adjacent to Rights of Way - Port Blakely has requested the option to restore up to 7 acres of cut or fill slopes resulting from construction of roads and stormwater ponds. After construction, the slopes would be blanketed with amended topsoil, stabilized with jute matting and planted with native vegetation. Undisturbed site soils are characterized by shallow duff/loam layers underlain by till. With time, the restored areas will provide a good approximation of the natural water-holding characteristics of surrounding undisturbed areas. Restored areas adjacent to roads or ponds would be delineated on the engineering plans, which would also include detailed reforestation/planting plans. Reforested area would not count against total allowable clearing.

Proposed Mitigations for the 14 acre Clearing Transfer

County staff have required that hydrologic impacts of any clearing in excess of limits established in the TPA or basin plan (i.e., 35% of the 150 acre development site, or 52.5 acres) be fully mitigated, even though there would be no net increase in allowable clearing considering both the Open Space parcel (40 acrs) and SE Rural development area (150 acres) together. (It should be noted that with the 180 acres

of open space to be dedicated to King County as part of the SE Rural development, the 40 acres to be dedicated as the Open Space parcel, and open space within the SE Rural development area proper, clearing totals only 18%.) To this end, Port Blakely proposes the following mitigation measures.

Soil Amendment - All areas cleared for lots and not covered by impervious surface or containing septic drainfield area will be layered with a minimum of 8" of amended soils (it is expected that primary drainfield areas will be counted as cleared, although they will retain native soils). Amended soils will comply with draft specifications including minimum organic content from 8 to 13% dry weight, fines ranging from 10 to 30 percent passing number 200 sieve (if imported), and 2" scarification of underlying till to preclude stratification.

The hydrologic benefits of amended soils are similar to those resulting from dispersion of developed runoff to native soils. Amended soils delay and reduce peak runoff rates. Compost-amended soil holds more moisture in winter, during times of peak precipitation. Amended soils have been shown to decrease runoff volumes by between 25% and 50% under unsaturated conditions (*Guidelines for Landscaping with Amended Soils*, Tracy Chollak/Paul Rosenfeld, January 1999).

Assuming the 42,080 sq ft of amended soil per lot and reforestation of 7 acres adjacent to roads and stormponds (see Table 2) is 8" deep in amended topsoil, 20% maximum soil moisture content (the maximum is more like 40%; assume the soil is "half wet"), and 80 lb/cf dry density of soil, the amended soils have capacity to hold some 330,000 cf of water. This is more than the total volume of all six proposed detention ponds.

Lot Dispersion BMPs - All lots, including those tributary to ponds, will be required to provide full dispersion BMPs as outlined in the draft update to the 1998 SWDM, as feasible. It is expected that the majority of lots will be well suited to application of full dispersion BMPs. Lots that do not discharge to stormwater ponds will comply with the requirements for Large Lot Low Impervious Projects as detailed in the draft update to the SWDM. Implementation will be through notes on the engineering plans and conditions of the final short plat documents.

The efficacy of dispersion as runoff control has been analyzed by King County staff to support updates to the SWDM, in which dispersion plays a prominent role. Proposed Large Lot Low Impervious Project requirements allow up to 45% impervious coverage with no flow control if full dispersion measures are implemented. Total impervious coverage in the SE Rural development area is limited to 8%.

Additional Detention - Stormwater pond detention and water quality volumes will be increased to accommodate the additional clearing and impervious surface on lots tributary to them. The ponds are sized with SBUH methodology to the BW-2 standard with a 30% factor of safety, as specified in both the TPA and basin plan. This detention performance standard is an approximation of the KCRTS Level 2 performance standard, and is intended to hold the duration of erosive developed

flow rates to predeveloped rates. Pond resizing will be done without regard to soil amendment measures or full dispersion BMPs applied to tributary lots as listed above, even though fully dispersed surfaces are subject to neither flow control nor water quality treatment in the draft manual.

Table 3 below summarizes results of an analysis of detention performance with and without soil amendments and dispersion BMPs. The analysis focuses on basin 4, one of six basins tributary to detention/water quality ponds. Scenarios 1 through 3 are SBUH analysis, consistent with the current design. SBUH pond volumes shown do not include the required 30% safety factor. A factor of safety is not required on the KCRTS pond. Details are included in the Appendix.

Scenario 1 is the pond as currently designed, with inflows from 1.06 acres of road and 5 developed lots at 6,750 sf impervious and 30,000 sf landscaping per lot.

Scenario 2 is the pond resized to accommodate increased lot impervious and clearing. Road impervious is held at 1.06 acres. Lot impervious is increased to 8,700 sf/lot and landscaping to 51,080 sf/lot (see Table 2).

Scenario 3 is performance of the resized pond considering soil amendments and dispersion BMPs. Lots were modeled as 50% effective impervious (conservative) to approximate dispersion of impervious surfaces and landscaping was modeled with a CN of 78 instead of 86 to approximate amended topsoil (Chollak, 1999).

Scenario 4 is performance of the resized pond (with reconfigured orifices) using KCRTS time series with lots modeled as 50% effective impervious (conservative) and landscaping modeled as till pasture.

	Det vol	2 / 10 / 100 inflows	2 / 10 / 100 outflows	KCRTS 8-yr Vol
Scenario 1 Current design	64,900 cf	2.79/5.19/8.37 cfs	0.74/1.48/3.23 cfs	279 ac-ft
Scenario 2 Resized pond	72,927 cf	3.19/5.67/9.00 cfs	0.74/1.48/3.23 cfs	---
Scenario 3 Perf w/ mitigation	69,278 cf	2.42/4.69/7.76 cfs	0.68/1.34/2.82 cfs	---
Scenario 4 KCRTS perf	86,952 cf	1.10/1.93/3.39 cfs	0.63/1.43/2.02 cfs	274 ac-ft

Table 3 - Detention Pond No. 4 Performance

In scenario 3, dispersal of lot impervious surfaces and use of amended soil in landscaped areas reduces peak flows, as compared to either Scenarios 1 or 2. Note peak flows are already reduced compared to predeveloped, due to the detention standard used.

In scenario 4, the developed, mitigated KCRTS time series is routed through the resized pond (with the 30% factor of safety). The pond performs in excess of Level 3, the highest detention performance standard, where 2-, 10- and 100-year predeveloped peaks are met or reduced, and predeveloped flow durations are

maintained. Equally as important, use of dispersion and amended soils maintains total runoff volume at current design volumes (some increase in runoff volumes compared to predeveloped volumes is unavoidable with changes in landcover due to development). Maintaining predeveloped flow durations and minimizing developed runoff volumes means that erosion of downstream ravines and the subsequent impact to streams is also minimized.

Summary

The proposed mitigations fully address hydrologic impacts of the additional clearing and impervious surface proposed in Amendment 2, and will result in a developed site that meets the intent of both Appendix D to the TPA and the Issaquah Creek Basin Plan.

1. The total clearing of the Open Space parcel and the SE Rural development area considered together does not exceed 35%. If the 180 acres of open space to be dedicated to King County is also considered, development of the SE Rural Area will clear only 18% of the parcels tributary to Issaquah Creek (66.5 acres of 370 acres).

2. Amended soils will be applied to all cleared areas of the lots not covered by impervious surface or drainfields to provide additional runoff storage volume. Full dispersion BMPs will be required of all lots, including those tributary to ponds. These measures represent the latest thinking in flow control for low density development, and will be required by the updated SWDM for most future rural residential development. Lots tributary to ponds will exceed future requirements, as formal flow control and water quality measures will also be applied.

3. Detention storage will be increased to accommodate the additional impervious surface and cleared areas tributary to them. Resulting detention pond performance not only meets the highest standard currently in use (Level 3), but also maintains runoff volumes at current design volumes.

B9 5.8-CR

BASINS 4A, 4B, 4C - PREDEVELOPED

- SCENARIO 1

  BASINS 4D, 4E, 4F - DEV, PER TIR

1.13 @ 98
15.76 @ 78.2

ROADS = 1.06 AC
5 LOTS @ 6750 sf = .77 AC
5 L/S @ 30,000 sf = 3.44 AC
UNCONVERTED = 12.32 AC
} 17.59 AC

PERV CN: 3.44 @ 86
12.32 @ 76
> 15.76 @ 78.2

(TCs FROM TIR)

- SCENARIO 2

  BASINS 4D1, 4E1, 4F1 - DEV, W/ MODIF CLEARING & IMP

2.06 @ 98
15.53 @ 79.8

ROADS = 1.06 AC
5 LOTS @ 8700 sf = 1.00 AC
5 L/S @ 51,080 sf = 5.86 AC
} 17.59 AC

UNCONVERTED = 9.67

1

PERV CN = 5.86 @ 86
9.67 @ 76 > 15.53 @ 79.8

- SCENARIO 3

BASINS 4D2, 4E2, 4F2

1.56 @ 98
16.03 @ 76.8

ROADS = 1.06 AC (8100 sf)
5 LOTS @ 4350 sf = .50 AC
(50% EFF IMP)
5 45 @ 55,430 sf = 6.36 AC (51,080 + 4350)
UNCONVERTED = 9.67 AC
} 17.59 AC

PERV CN: 6.36 @ 78 (AMENDED SOIL)
9.67 @ 76 > 16.03 @ 76.8

ISSAQUAH HIGHLANDS - SE RURAL
DETENTION POND DESIGN
BASIN 4

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BASIN SUMMARY

BASIN ID: BASIN4A NAME: 2 YR, 24 HR PREDEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	2.90 inches	AREA..:	17.59 Acres	0.00 Acres
TIME INTERVAL....:	10.00 min	CN....:	76.00	0.00
		TC....:	57.40 min	0.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.1350
TcReach - Shallow L: 882.00 ks:3.00 s:0.1350
PEAK RATE: 1.48 cfs VOL: 1.39 Ac-ft TIME: 540 min

BASIN ID: BASIN4B NAME: 10 YR, 24 HR PREDEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	4.00 inches	AREA..:	17.59 Acres	0.00 Acres
TIME INTERVAL....:	10.00 min	CN....:	76.00	0.00
		TC....:	57.40 min	0.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.1350
TcReach - Shallow L: 882.00 ks:3.00 s:0.1350
PEAK RATE: 3.23 cfs VOL: 2.55 Ac-ft TIME: 490 min

BASIN ID: BASIN4C NAME: 100 YR, 24 HR PREDEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	5.30 inches	AREA..:	17.59 Acres	0.00 Acres
TIME INTERVAL....:	10.00 min	CN....:	76.00	0.00
		TC....:	57.40 min	0.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.1350
TcReach - Shallow L: 882.00 ks:3.00 s:0.1350
PEAK RATE: 5.81 cfs VOL: 4.08 Ac-ft TIME: 490 min

BASIN SUMMARY

BASIN ID: BASIN4D NAME: 2 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	2.90 inches	AREA..:	15.76 Acres	1.83 Acres
TIME INTERVAL....:	10.00 min	CN....:	78.20	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 2.79 cfs VOL: 1.81 Ac-ft TIME: 480 min

BASIN ID: BASIN4D1 NAME: 2 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	2.90 inches	AREA..:	15.53 Acres	2.06 Acres
TIME INTERVAL....:	10.00 min	CN....:	79.80	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 3.19 cfs VOL: 1.96 Ac-ft TIME: 480 min

BASIN ID: BASIN4D2 NAME: 2 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	2.90 inches	AREA..:	16.03 Acres	1.56 Acres
TIME INTERVAL....:	10.00 min	CN....:	76.80	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 2.42 cfs VOL: 1.67 Ac-ft TIME: 480 min

BASIN SUMMARY

BASIN ID: BASIN4E NAME: 10 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	4.00 inches	AREA..:	15.76 Acres	1.83 Acres
TIME INTERVAL....:	10.00 min	CN....:	78.20	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 5.19 cfs VOL: 3.07 Ac-ft TIME: 480 min

BASIN ID: BASIN4E1 NAME: 10 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.54 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	4.00 inches	AREA..:	15.53 Acres	2.01 Acres
TIME INTERVAL....:	10.00 min	CN....:	79.80	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 5.67 cfs VOL: 3.25 Ac-ft TIME: 480 min

BASIN ID: BASIN4E2 NAME: 10 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	4.00 inches	AREA..:	16.03 Acres	1.56 Acres
TIME INTERVAL....:	10.00 min	CN....:	76.80	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 4.69 cfs VOL: 2.89 Ac-ft TIME: 480 min

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BASIN SUMMARY

BASIN ID: BASIN4F NAME: 100 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	5.30 inches	AREA..:	15.76 Acres	1.83 Acres
TIME INTERVAL....:	10.00 min	CN....:	78.20	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 8.37 cfs VOL: 4.69 Ac-ft TIME: 480 min

BASIN ID: BASIN4F1 NAME: 100 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	5.30 inches	AREA..:	15.53 Acres	2.06 Acres
TIME INTERVAL....:	10.00 min	CN....:	79.80	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 9.00 cfs VOL: 4.93 Ac-ft TIME: 480 min

BASIN ID: BASIN4F2 NAME: 100 YR, 24 HR DEV.
SBUH METHODOLOGY

TOTAL AREA.....:	17.59 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	5.30 inches	AREA..:	16.03 Acres	1.56 Acres
TIME INTERVAL....:	10.00 min	CN....:	76.80	98.00
		TC....:	41.93 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.8000 p2yr: 2.90 s:0.2310
TcReach - Shallow L: 348.00 ks:3.00 s:0.2310
TcReach - Channel L: 505.00 kc:17.00 s:0.0440
PEAK RATE: 7.76 cfs VOL: 4.48 Ac-ft TIME: 480 min

ISSAQUAH HIGHLANDS - SE RURAL
DETENTION POND DESIGN
BASIN 4

STORAGE STRUCTURE LIST

TRAPEZOIDAL BASIN ID No. P3
Description: DETENTION POND FOR BASIN 3
Length: 34.00 ft. Width: 105.00 ft.
Side Slope 1: 3 Side Slope 3: 3
Side Slope 2: 3 Side Slope 4: 3
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. P3+30%
Description: DETENTION POND FOR BASIN 3
Length: 34.00 ft. Width: 145.00 ft.
Side Slope 1: 3 Side Slope 3: 3
Side Slope 2: 3 Side Slope 4: 3
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. P4
Description: DETENTION POND FOR BASIN 4
Length: 50.00 ft. Width: 290.00 ft.
Side Slope 1: 3 Side Slope 3: 3
Side Slope 2: 3 Side Slope 4: 3
Infiltration Rate: 0.00 min/inch

PER CURRENT PLANS

TRAPEZOIDAL BASIN ID No. P4+30%
Description: DETENTION POND FOR BASIN 4
Length: 52.00 ft. Width: 370.00 ft.
Side Slope 1: 3 Side Slope 3: 3
Side Slope 2: 3 Side Slope 4: 3
Infiltration Rate: 0.00 min/inch

TRAPEZOIDAL BASIN ID No. P41
Description: DETENTION POND FOR BASIN 4
Length: 50.00 ft. Width: 290.00 ft.
Side Slope 1: 3 Side Slope 3: 3
Side Slope 2: 3 Side Slope 4: 3
Infiltration Rate: 0.00 min/inch

RESIZED FOR ADDN'L CLEARING, IMPERVIOUS

DISCHARGE STRUCTURE LIST

MULTIPLE ORIFICE ID No. O3
Description: FLOW RESTRICTOR - BASIN 3
Outlet Elev: 1114.00
Elev: ~~1112.00 ft~~ Orifice Diameter: 2.6309 in.
Elev: 1117.20 ft Orifice 2 Diameter: 2.9707 in.
Elev: 1118.30 ft Orifice 3 Diameter: 6.1172 in.

MULTIPLE ORIFICE ID No. O4
Description: FLOW RESTRICTOR - BASIN 4
Outlet Elev: 1109.00
Elev: 1107.00 ft Orifice Diameter: 4.3008 in.
Elev: 1111.30 ft Orifice 2 Diameter: 5.0391 in.
Elev: 1112.20 ft Orifice 3 Diameter: 9.7266 in.

PER CURRENT PLANS

MULTIPLE ORIFICE ID No. O41
Description: FLOW RESTRICTOR - BASIN 4
Outlet Elev: 1109.00
Elev: 1107.00 ft Orifice Diameter: 4.1543 in.
Elev: 1111.60 ft Orifice 2 Diameter: 4.9922 in.
Elev: 1112.50 ft Orifice 3 Diameter: 9.4219 in.

RESIZED

SCENARIO 1
CURRENT PLANS

Þ File Input Hydrograph Storage Discharge LPool Proj: 97366-2
Concept Engineering
Display Level Pool Results

Description	Match Peak	Inflow Peak	Storage ID	Disch ID	Peak Stage	Peak Volume	Peak Out
2 YR DESIGN STORM	0.74	2.79	P4	O4	1111.17	36425	0.74
10 YR DESIGN STORM	1.48	5.19	P4	O4	1112.06	54300	1.48
100 YR DESIGN STORM	3.23	8.37	P4	O4	1112.55	64900	3.23

(½ PRE 2 = .74
PRE 2 = 1.48
PRE 10 = 3.23)

IN: BASINS 4D, 4E, 4F

Ok É

SCENARIO 2

RETRO FOR POND'L CURVE, Imp

File Input Hydrograph Storage Discharge LPool Proj: 97366-2

Concept Engineering

Display Level Pool Results

Description	Match Peak	Inflow Peak	Storage ID	Disch ID	Peak Stage	Peak Volume	Peak Out
2 YR DESIGN STORM	0.74	3.19	P41	O41	1111.50	42812	0.74
10 YR DESIGN STORM	1.48	5.67	P41	O41	1112.42	61949	1.48
100 YR DESIGN STORM	3.23	9.00	P41	O41	1112.91	72927	3.23

IN: BASINS 401, 4E1, 4F1

Ok É

SCENARIO 3
w/ AMC 060 SOILS, DISPERSION THROUGH RESIZED PONDS

Þ File Input Hydrograph Storage Discharge LPool Proj: 97366-2

Concept Engineering

Display Level Pool Results

Description	Match Peak	Inflow Peak	Storage ID	Disch ID	Peak Stage	Peak Volume	Peak Out
2 YR DESIGN STORM	0.74	2.42	P41	O41	1111.08	34695	0.68
10 YR DESIGN STORM	1.48	4.69	P41	O41	1112.16	56428	1.34
100 YR DESIGN STORM	3.23	7.76	P41	O41	1112.75	69278	2.82

W/ BASINS 4D2, 4E2, 4F2

Ok É

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

---Annual Peak Flow Rates---			------Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
1.78	2	2/09/01 18:00	2.11	1	100.00	0.990
0.289	7	1/05/02 16:00	1.78	2	25.00	0.960
1.13	4	2/28/03 16:00	1.45	3	10.00	0.900
0.204	8	3/03/04 3:00	1.13	4	5.00	0.800
1.04	5	1/05/05 10:00	1.04	5	3.00	0.667
0.837	6	1/18/06 21:00	0.837	6	2.00	0.500
1.45	3	11/24/06 5:00	0.289	7	1.30	0.231
2.11	1	1/09/08 7:00	0.204	8	1.10	0.091
Computed Peaks			2.00		50.00	0.980

.PRE.TSF

17,59 AC TF

(AN), 1.1

Flow Frequency Analysis
Time Series File:scenario3.tsf
Project Location:Landsburg

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
2.08	2	2/09/01	14:00	3.39	1	100.00	0.990
0.631	8	1/05/02	16:00	2.08	2	25.00	0.960
1.46	4	2/28/03	16:00	1.93	3	10.00	0.900
1.10	6	8/26/04	1:00	1.46	4	5.00	0.800
1.36	5	1/05/05	10:00	1.36	5	3.00	0.667
1.09	7	1/18/06	16:00	1.10	6	2.00	0.500
1.93	3	11/21/06	9:00	1.09	7	1.30	0.231
3.39	1	1/09/08	7:00	0.631	8	1.10	0.091
Computed Peaks				2.95		50.00	0.980

SCENARIO 3 – INFLOW TSF

1.56 INP
6.36 TP
9.67 TF
Low, 1.1

w/ DISPERSION, AMENDED SOILS

↓ 50% EFF INP

↓ TP INSTEAD OF TG

"POND 4"

CHECK RCRTS PERF.

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	290.00	ft
Pond Bottom Width:	65.00	ft
Pond Bottom Area:	18850.	sq. ft
Top Area at 1 ft. FB:	32926.	sq. ft
	0.756	acres
Effective Storage Depth:	5.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	122375.	cu. ft
	2.809	ac-ft
Riser Head:	6.00	ft
Riser Diameter:	36.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	3.00	0.598	
2	2.40	4.00	0.823	6.0
3	3.30	5.00	1.114	8.0

ORIFICE Ø ADJ

Top Notch Weir: None
Outflow Rating Curve: None

Route Time Series through Facility
Inflow Time Series File:scenario3.tsf
Outflow Time Series File:rdout

Inflow/Outflow Analysis

Peak Inflow Discharge:	3.39	CFS at	7:00	on Jan 9	in Year 8
Peak Outflow Discharge:	2.02	CFS at	19:00	on Jan 9	in Year 8
Peak Reservoir Stage:	4.77	Ft			
Peak Reservoir Elev:	4.77	Ft			
Peak Reservoir Storage:	86952.	Cu-Ft			
:	1.996	Ac-Ft			

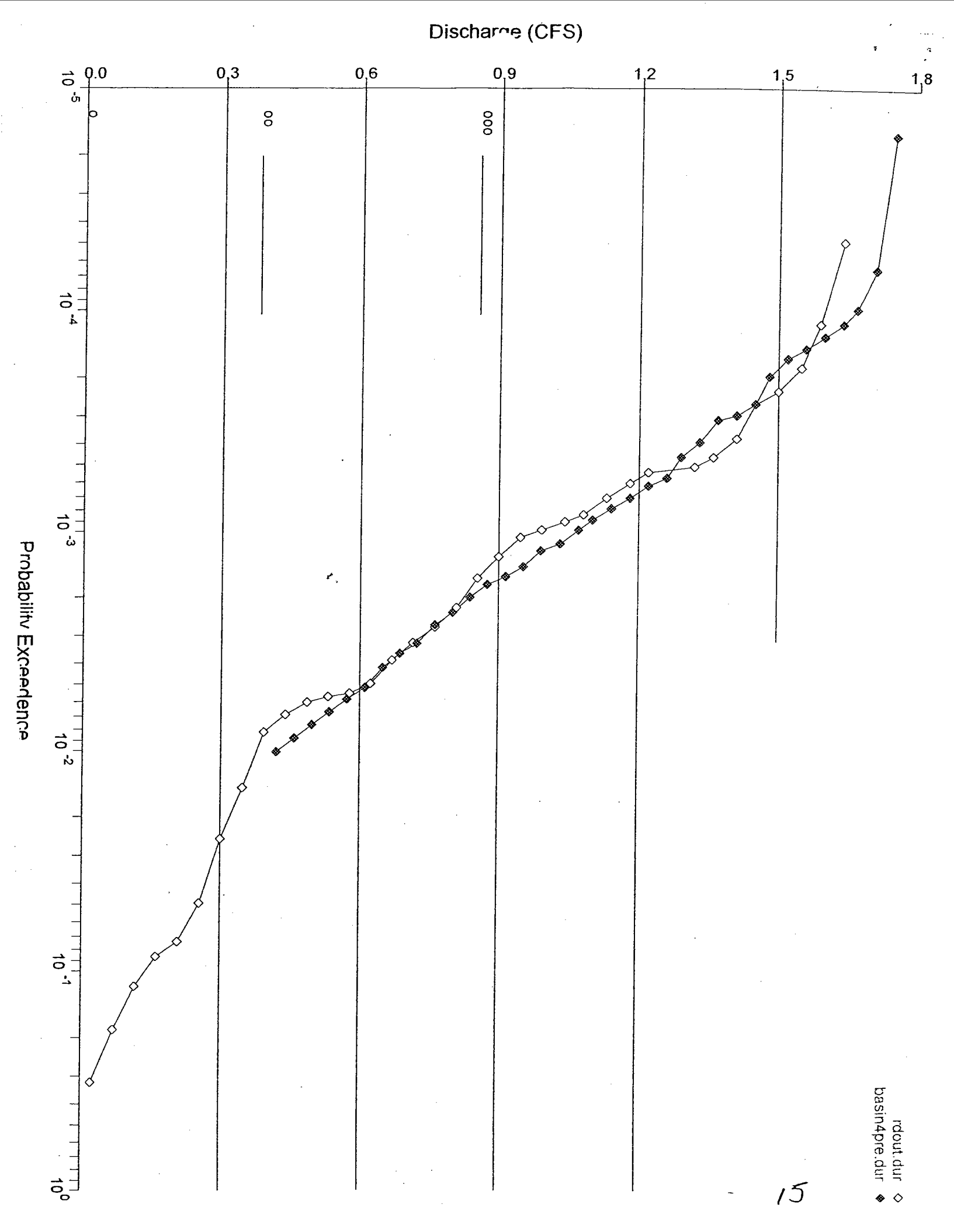
← FITS IN RESIZED POND

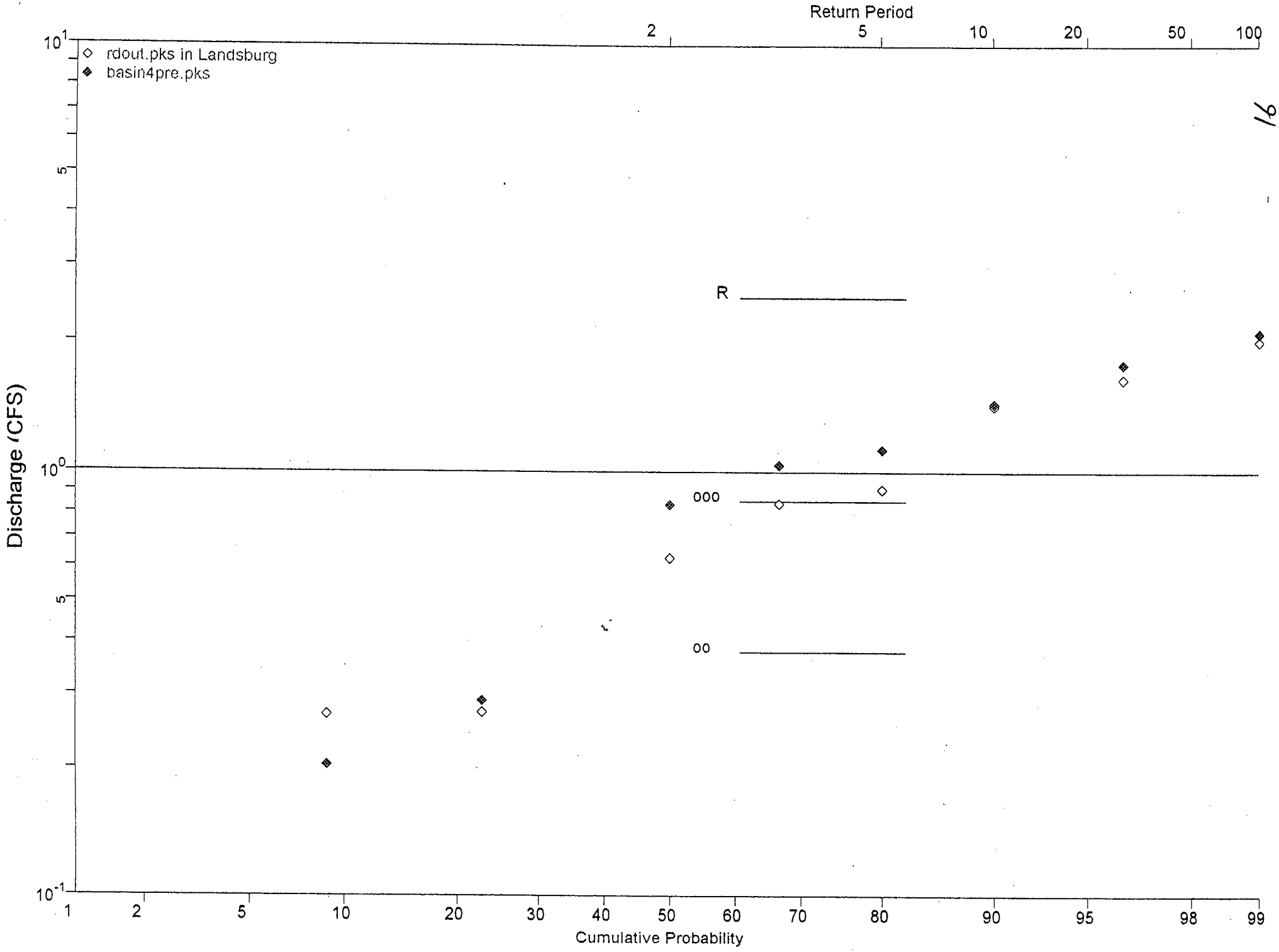
(= 1.3 x 69278 = 90,061 cf)

↑ SBUH SCENARIO 3

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

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
1.65	2	2/09/01 20:00	2.02	4.77	1	100.00	0.990
0.268	8	12/04/01 4:00	1.65	4.07	2	25.00	0.960
0.910	4	3/01/03 7:00	1.43	3.75	3	10.00	0.900
0.271	7	8/26/04 4:00	0.910	3.39	4	5.00	0.800
0.844	5	1/05/05 19:00	0.844	3.26	5	3.00	0.667
0.629	6	1/19/06 7:00	0.629	2.68	6	2.00	0.500
1.43	3	11/24/06 8:00	0.271	1.24	7	1.30	0.231
2.02	1	1/09/08 19:00	0.268	1.21	8	1.10	0.091
Computed Peaks			1.90	4.50		50.00	0.980


Discharge (CFS)
0.0
0.3
0.6
0.9
1.2
1.5
1.8
Probability Exceedence
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
rdout.dur
basin4pre.dur


Return Period
2
5
10
20
50
100
rdout.pks in Landsburg
basin4pre.pks
R
000
00
Discharge (CFS)
10^1
5
10^0
5
10^{-1}
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
Cumulative Probability

16

Discharge Volume from Time Series (CURRENT DESIGN)
scenario1.tsf
between 10/01/00 00:00 and 09/30/08 23:59
12173989. Cu-Ft or 279.476 Ac-Ft in 2920.0 days

TSF: 1.83 IMP
3.99 TG
12.32 TF
CNN, 1.1

Discharge Volume from Time Series (AMENDED SOIL, 50% EFF IMP ON LOTS ONLY)
scenario3.tsf
between 10/01/00 00:00 and 09/30/08 23:59
11936842. Cu-Ft or 274.032 Ac-Ft in 2920.0 days

TSF: 1.56 IMP
6.36 TP
9.67 TF
CNN, 1.1

BG 5.3.02

MOISTURE HOLDING CAPACITY OF AMENDED TOP SOIL —

- ASSUME 40% MOISTURE CONTENT MAX
- 80 lb/cf DRY DENSITY

(42,080/LOT + 7AC)

- 45.6 AC x 8" DEEP TOPSOIL
  = 1,325,413 cf TOPSOIL

- ASSUME 80 lb/cf FOR UNCOMPACTED TOPSOIL
- ASSUME 40% MAX MOISTURE CONTENT
- ASSUME TOPSOIL IS "HALF WET"
  (i.e., 20% MOISTURE CONTENT)
- NOM'L HOLDING CAPACITY

= (.2)(80 lb/cf) = 16 lb WATER/cf

(16 lb WATER/cf)(64.4 lb WATER/cf)
= .25 cf WATER / cf TOPSOIL

(.25)(1,325,413 cf) = 330,000 cf
NOM'L HOLDING CAPACITY

TECHNICAL MEMORANDUM

To:	John Adams, Port Blakely Carol Beck, Port Blakely	Date:	June 7, 2002
From:	Kerensa Fromherz, P.E. Larry Toedtli, P.E.	TG:	00332.03
cc:	Bill Hoffman, Issaquah MDRT		
Subject:	Supplemental Analysis for *Transportation Impact Analysis – Issaquah Highlands Phase 1B and 1C*		

The Transpo Group previously prepared an analysis of potential traffic impacts of the proposed development phases, termed Phase 1B and Phase 1C. The findings were documented in the *Transportation Impact Analysis – Issaquah Highlands Phase 1B and 1C* report prepared in March 2002. Two Phase 1C development scenarios were analyzed as part of the report: Scenario 1 consisting of 1,055 equivalent residential units (ERUs) and 250 thousand square feet (ksf) office, and Scenario 2 consisting of 1,338 ERUs and 4 ksf office. Both scenarios were analyzed assuming residential trip generation for the new ERUs would be the same as that observed for the existing portion of the development (approximately 6.35 trips per day per dwelling).

This memo has been prepared to provide a detailed description of the anticipated background traffic on Black Nugget Road, and to document the anticipated traffic impacts associated with a third land use scenario. The trip generation rate of 9.57 trips per day per dwelling reported in the *Trip Generation Handbook* (ITE, 1997) is used for all proposed new residential units, rather than the much lower observed rate.

Daily Traffic Volume on Black Nugget Road

In accordance with the Grand Ridge Final Environmental Impact Statement, the total average daily traffic (ADT) on Black Nugget Road shall not exceed 8,500 vehicles per day (vpd). The ADT is comprised of three components: existing Issaquah Highlands traffic, background traffic, and proposed Issaquah Highlands traffic resulting from additional residential or commercial development.

Existing Issaquah Highlands Traffic

As reported in *Transportation Impact Analysis – Issaquah Highlands Phase 1B and 1C*, an average daily traffic volume (ADT) of approximately 3,500 vpd was observed on Black Nugget Road, of which approximately 2,800 vpd were generated by Issaquah Highlands. At the time of the traffic counts (October 2001), 441 ERUs were fully constructed and occupied. An additional 139 ERUs are approved as part of Phase 1A of the development and were under construction when the traffic counts

were collected. The 580 ERUs approved as part of Phase 1A would result in approximately 3,685 vpd on Black Nugget Road. With the completion of the South SPAR to I-90 westbound on-ramp, it is expected that approximately 56 percent of the outbound traffic will travel on the new connection, with the remainder of the outbound and inbound traffic traveling on Black Nugget Road. Therefore, the approved Phase 1A ERUs would generate a total of 2,650 vpd on Black Nugget Road.

Background Traffic

Of the observed 3,500 vpd on Black Nugget Road, approximately 700 vpd were local Black Nugget Road trips. This volume is not expected to change significantly over the next two years, as no new housing developments are being constructed along Black Nugget Road and some existing homes have been closed due to construction of the North SPAR. However, new background traffic will be added to Black Nugget Road in the form of construction traffic and regional traffic shifting to the new connection to I-90.

Construction traffic has been detailed in the memo prepared by Transpo titled *Issaquah Highlands – Microsoft Construction Traffic* dated June 6, 2002. The memo reports that up to a total of 426 daily construction trips are expected to be added to Black Nugget Road.

With the opening of the South SPAR to I-90 westbound on-ramp, there is a potential for some regional re-distribution of traffic from Issaquah-Fall City Road to the South SPAR via Black Nugget Road. For the purposes of this analysis, we have assumed that approximately 225 vehicles per day would choose the new route to I-90. The majority of these trips would occur during the AM peak period, in order to avoid delays associated with the East Lake Sammamish Parkway/I-90 interchange. The volume is based on an estimated number of vehicles per hour that could reasonably be accommodated by the Issaquah Fall City Road/Black Nugget Road intersection through the south-to-east left turn movement. This is likely to be a conservative estimate for the following reasons:

1. **Nature of the Site.** Although the South SPAR will be completed between D Drive and I-90 and will be accessible to Issaquah Highlands traffic, the full town center couplet is not expected to be completed and fully operational. It is our understanding at this time that construction will be phased such that all traffic will travel on one side of the couplet while the other side is being constructed, and intersection traffic signals would not be installed and operational until the roadway is completed. Meanwhile, the town center intersections will likely be controlled by stop signs. The unfinished nature of the couplet and town center construction site will likely deter most drivers from traveling through the site to reach I-90. Traveling through the site would mean an increased total travel distance of approximately 1 mile. Signs deterring through-traffic and identifying the construction zone will be in place and may help deter through vehicles.

2. **Signal Timing**. The traffic signal at the Issaquah-Fall City Road/Black Nugget Road intersection has a protected southbound left phase and a protected (split) eastbound through phase. If the signal timing remains unchanged and the approach storage lengths remain unchanged, new traffic would not be encouraged to travel on Black Nugget Road. A point would be reached where the traffic would experience increased delay, due to the increased demand to turn onto Black Nugget Road, such that the detour would no longer represent an overall travel time savings.

The existing and new background traffic described above is summarized in Table 1.

Table 1

Black Nugget Road - Background Traffic	
Traffic Source	ADT (vehicles per day)[1]
Existing	700
Construction	425
Regional	225
Total	1,350

1. Rounded to nearest 5 vehicles per day.

Proposed Issaquah Highlands Traffic

The approved Phase 1A development consists of 580 ERUs and 250 ksf of office space. Given the anticipated completion of the South SPAR to I-90 westbound on-ramp and the associated redistribution of outbound trips, additional land use could be accommodated within the 8,500 ADT limit on Black Nugget Road. Two scenarios for additional land use were evaluated in the *Transportation Impact Analysis – Issaquah Highlands Phase 1B and 1C*. Both scenarios were evaluated using observed trip generation rates. Three new scenarios are presented below, using the *Trip Generation Handbook* rates. Using the revised trip generation rates, Phase 1B is eliminated and each scenario assumes the South SPAR to I-90 westbound on ramp is completed by 2003.

- 369 new ERUs (969 total) and 246 ksf new office (250 ksf total)
- 652 new ERUs (1,232 total) and no new office (4 ksf total)
- 510 new ERUs (1,090 total) and 123 ksf new office (127 ksf total)

While it is unlikely that all the proposed new construction could be approved, developed, sold and occupied within the next 12 months, a worst case analysis is presented to evaluate the maximum possible ADT on Black Nugget Road compared to the 8,500-vpd threshold. The projected ADT for each of the three scenarios are summarized in Table 2.

Table 2

Added ADT to Black Nugget Road			
Traffic Source	Residential ADT (vpd)[1]	Office ADT (vpd)[1]	Total ADT (vpd)[1]
369 new ERUs and 246 ksf new office	2,545	1,950	4,495
652 new ERUs and no new office	4,495	0	4,495
510 new ERUs and 123 ksf new office	3,515	975	4,490

1. Rounded to nearest 5 vehicles per day.

Black Nugget Road ADT Summary

The attached Figure A summarizes the existing and proposed Black Nugget traffic volumes – including the existing volumes, background traffic and proposed trip generation described above. Each bar shown on the chart is summarized below.

- **Existing**. Traffic counts show that approximately 2,800 vpd are generated by the existing 441 ERUs in Issaquah Highlands and an additional 700 vpd are generated by Black Nugget Road residents.
- **Phase 1A, Approved**. A total of 5,330 vpd would be expected to travel on Black Nugget Road with the construction and use of the already approved 580 ERUs and 250 ksf office. This assumes the South SPAR to I-90 on-ramp is constructed and open.
- **Phase 1C, Office Fully Occupied**. An additional 369 ERUs could be added to the approved Phase 1A development described above, prior to reaching the 8,500-vpd limit on Black Nugget Road. This scenario assumes that all development is fully constructed and occupied, and that the South SPAR to I-90 on-ramp is constructed and open.
- **Phase 1C, Proposed**. The 1,950 vpd that would be generated by the 246-ksf office space as part of the approved Phase 1A could be replaced by an additional 283 ERUs if the office were not allowed until the full SPAR/I-90 interchange is complete and open. This would result in 652 ERUs in Phase 1C and a total of 1,232 ERUs for all of Phase 1.
- **Phase 1C, Recommended**. City staff recommends temporarily converting half of the office uses to residential uses for the purpose of phased construction, allowing occupation of the remaining office space if finished, and allowing construction and occupation of 141 additional ERUs for Phase 1C. This would result in a total of 1,090 ERUs for all of Phase 1.
- **Expected**. The final column is shown for informational purposes only - to compare the ADT that will likely occur on Black Nugget Road in 2003 with the maximum ADT for the same proposed land use shown as the Recommended scenario. The office space is not expected to generate any trips, as it is not likely that the developer of the office space could grade the site, receive building permits, negotiate contracts, complete construction and have any of the space occupied by 2003. Similarly, it is not likely that

the developer of the residential space could complete construction and have all units sold and occupied by 2003. Therefore, it is conservatively assumed that a maximum of 60 percent of the units would be fully occupied in 2003. It is also assumed that the units would generate trips at a similar rate to the units that are currently built and occupied. The ADT for the Expected Scenario is approximately 3,100 vpd less than 8,500 vpd threshold for Black Nugget Road identified in the Grand Ridge Final Environmental Impact Statement.

Traffic Operations for Proposed Land Use

Traffic operations analysis has been prepared for the Recommended development scenario described above, assuming that 60 percent of the new residential units could be constructed and occupied over the next year (within 2003). This assumption is believed to be conservative, given the typical time required for construction, sale and unit occupation. Trip generation rates used for the analysis are taken from the *Trip Generation Handbook*. The rates cited in the *Handbook* are higher than rates observed to be generated by the existing 441 ERUs on site; daily rates are 51 percent higher, AM peak hour rates are 53 percent higher, and PM peak hour rates are 87 percent higher than the observed rates. Trip generation for the scenario is summarized in Table 3.

Table 3

Peak Hour Trip Generation							
	Daily (veh/day)	AM Peak (veh/hr)			PM Peak (veh/hr)		
Land Use	Total	In	Out	Total	In	Out	Total
Phase 1A - Approved							
580 ERUs[1]	3,683	41	247	288	203	109	312
Phase 1C - Proposed							
510 ERUs - 60% occupied	4,881	33	196	229	201	108	309
123 ksf office	1,354	169	23	192	31	152	183

1. From Traffic Volumes observed during counts collected in October 2001

The trips generated according to Table 3 were distributed and assigned to the traffic network in accordance with the methods and assumptions detailed in *Transportation Impact Analysis – Issaquah Highlands Phase 1B and 1C*. Level of service (LOS) calculations were then performed for the identified study area intersections, in accordance with the *Highway Capacity Manual* (TRB, 2000) methodology. The resulting intersection levels of service, vehicle delay and volume-to-capacity (v/c) ratios are summarized in Table 4, relative to those originally tabulated for the full Phase 1A Scenario.

Table 4

Phase 1C Level of Service Summary

Intersection	Phase 1 Approved 580 ERUs & 250ksf off.			Phase 1C Proposed 1,090 ERUs & 127ksf off..		
AM Peak Hour	LOS[1]	Delay[2]	V/C[3]	LOS	Delay	V/C
SE 56th St/ELSP[4]	F	97.3	1.13	F	93.5	1.12
Black Nugget Rd/ELSP	D	43.8	0.52	D	43.3	0.51
SE 62nd St/ELSP	C	32.4	0.52	C	31.2	0.52
Issaquah-Fall City Road/ELSP	F	317.6	1.03	F	263.1	0.92
I-90 WB Ramps/ELSP	F	170.8	1.05	F	172.9	1.03
I-90 EB Ramps/Front St	C	29.3	0.74	C	28.1	0.70
Gilman Blvd/Front St	D	42.8	0.68	D	43.5	0.67
Black Nugget Road/ Issaquah-Fall City Rd	D	23.7	0.78	C	20.5	0.77
Issaquah-Pine Lake Rd/ Issaquah-Fall City Rd	C	29.3	0.81	C	28.2	0.80
PM Peak Hour	LOS	Delay	V/C	LOS	Delay	V/C
SE 56th St/ELSP	E	72.0	1.05	E	71.8	1.05
Black Nugget Rd/ELSP	B	16.6	0.67	B	10.9	0.64
SE 62nd St/ELSP	F	268.6	1.36	F	261.4	1.35
Issaquah-Fall City Road/ELSP	F	127.6	1.30	F	106.8	1.24
I-90 WB Ramps/ELSP	C	31.1	0.93	C	32.2	0.96
I-90 EB Ramps/Front St	F	107.3	1.18	F	112.7	1.20
Gilman Blvd/Front St	E	73.4	0.97	E	67.6	0.96
Black Nugget Road/ Issaquah-Fall City Rd	E	57.6	1.02	D	53.2	0.98
Issaquah-Pine Lake Rd/ Issaquah-Fall City Rd	C	29.4	0.98	C	28.5	0.98

1. LOS – Level of Service
2. Delay measured in seconds per vehicle
3. V/C – volume-to-capacity ratio
4. ELSP – East Lake Sammamish Parkway

The proposed Phase 1C development does not cause the LOS at any given intersection to worsen. Three intersections in the AM peak hour and six intersections in the PM peak hour were identified to operate below LOS D both with and without Phase 1C. The impact of the additional development to those particular intersections is summarized in the attached Figures B and C. In six cases, the impact is considered "marginal" – that is, the delay per vehicle is not increased or decreased by more than five seconds. The delay experienced at the intersection of Issaquah-Fall City Road and East Lake Sammamish Parkway is reduced by 54 seconds per vehicle during the AM peak period and 21 seconds per vehicle in the PM peak period. This intersection has the highest overall delay of the study area intersections, so the decrease in delay with the shift in traffic to I-90 is very important to system operations.

Conclusions

Of the three proposed development scenarios, the recommended scenario includes the construction of 1,090 ERUs (510 new ERUs, in addition to the Phase 1A approved 580 ERUs) and 123 ksf office (half of the 246 ksf office approved as part of Phase 1A). Given the trip generation rates in the *Trip Generation Handbook*, full construction and occupation of this development would not surpass the 8,500-ADT limit on Black Nugget Road. The ADT estimate of 8,495 vpd is conservative, given that the office and all dwelling units are not likely to be fully constructed and occupied in 2003 and that lower trip generation rates have been observed at the site.

Assuming full occupation of the 123 ksf office and 60 percent occupation of the dwelling units, the impacts of the Recommended Phase 1C scenario are marginal, and are all improved over the Phase 1C scenarios analyzed as part of the *Transportation Impact Analysis – Issaquah Highlands Phase 1B and 1C*. The assumptions that the office will be fully occupied and that the residential units will be 60 percent occupancy assumption are both conservative, based on observed timelines from permits to occupation.

Please contact Kerensa Fromherz or Larry Toedtli if you have any questions or require additional information.

Attachments

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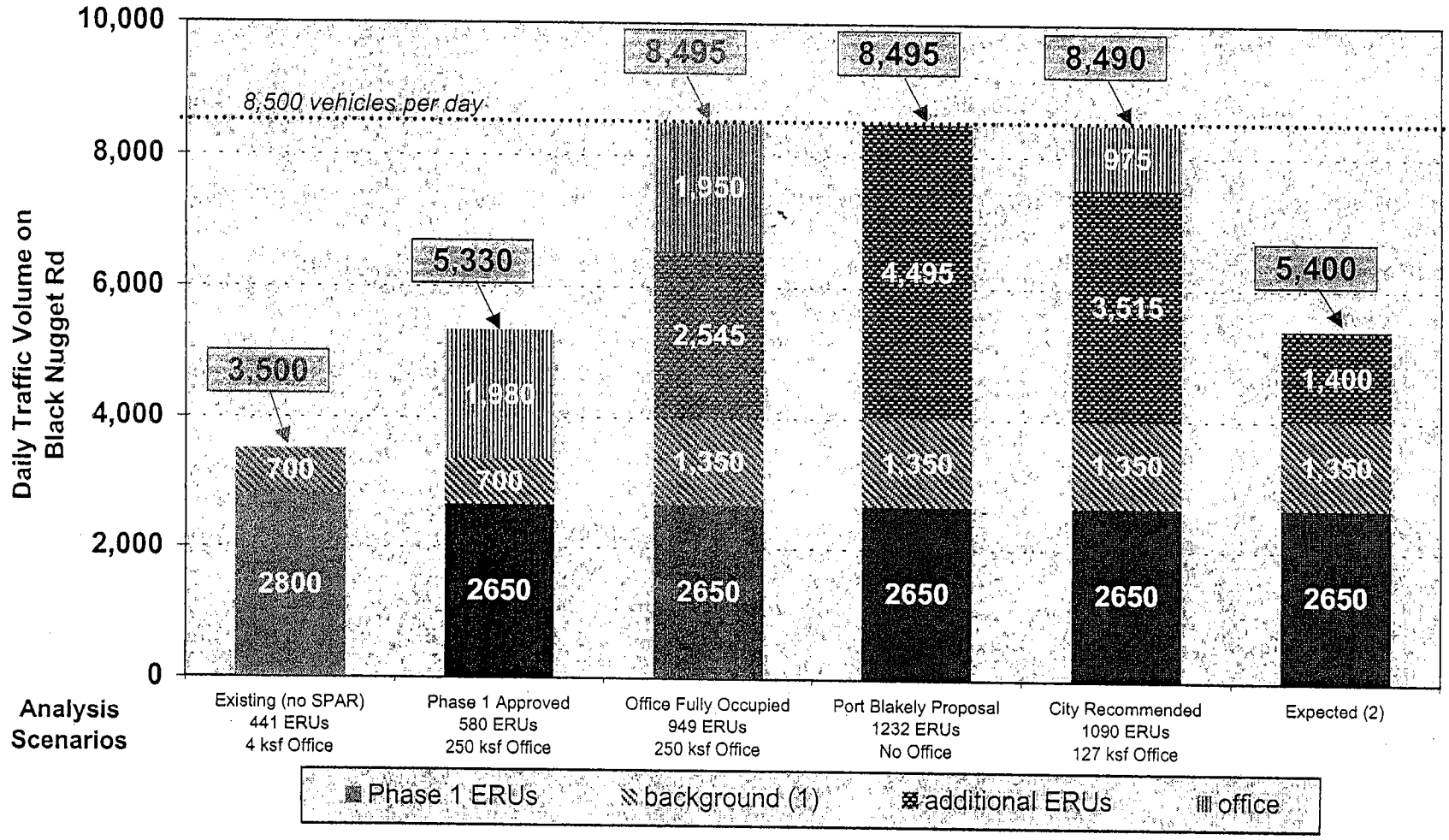
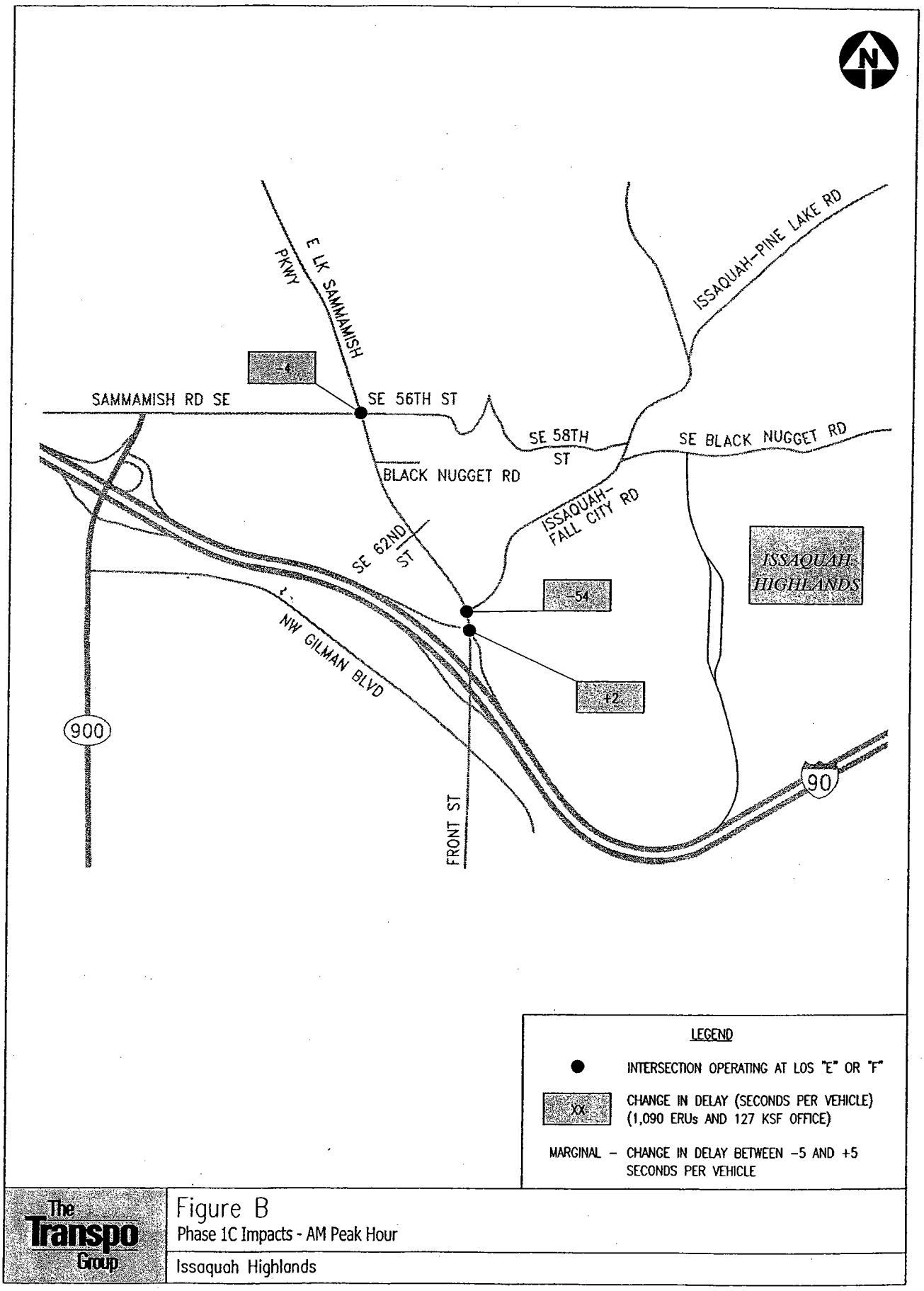
Figure A - Projected Daily Traffic on Black Nugget Road



Note (1): Background traffic includes existing Black Nugget Road traffic, anticipated construction traffic and regional cut-through traffic.
Note (2): Expected traffic reflects a lower trip generation rate comparable to that observed at the site, 60% occupance of new residential units and no occupied offices.



The Transpo Group

Figure B
Phase 1C Impacts - AM Peak Hour
Issaquah Highlands

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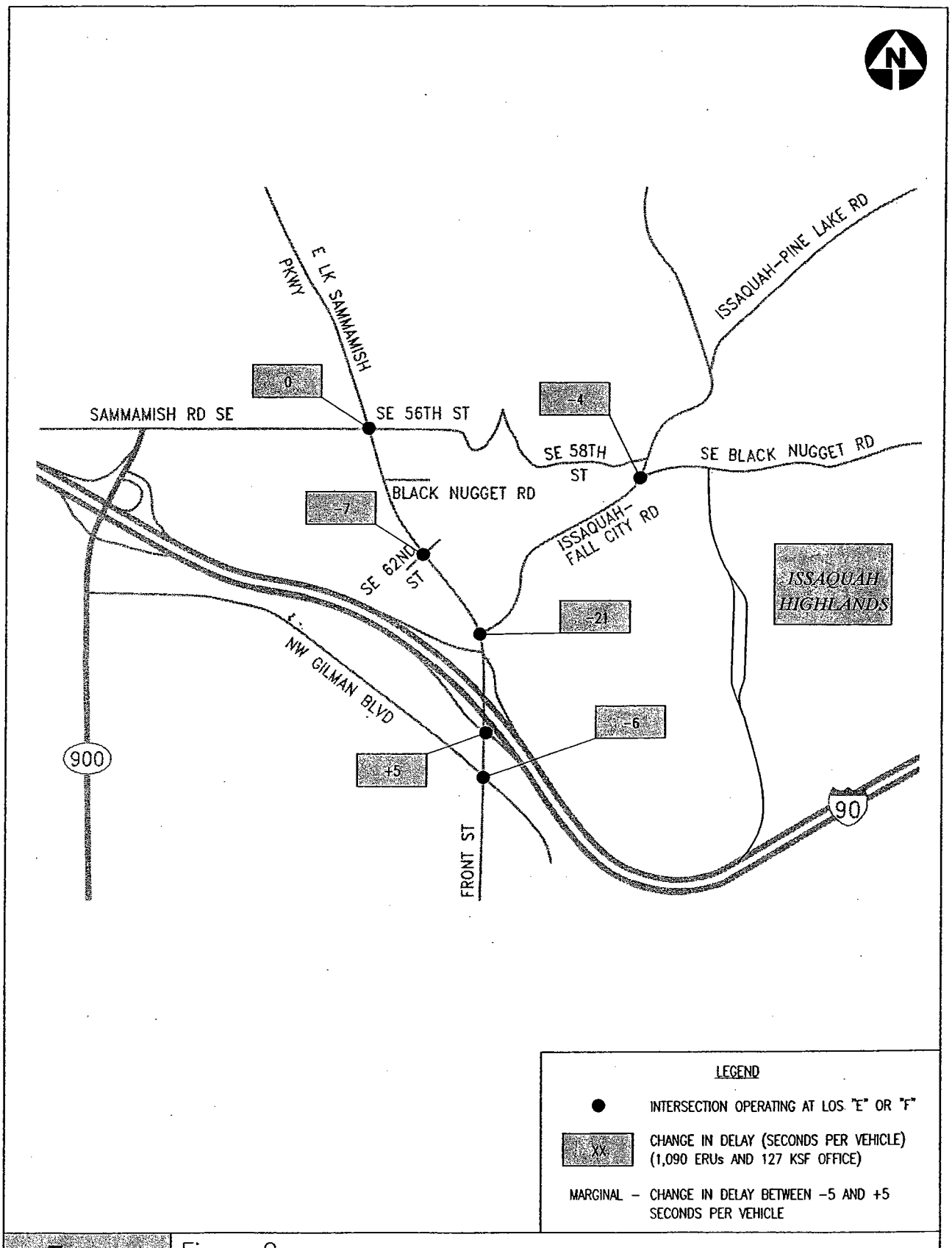

The Transpo Group

Figure C
Phase 1C Impacts - PM Peak Hour

Issaquah Highlands

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TECHNICAL MEMORANDUM

To:	John Adams, Port Blakely Carol Beck, Port Blakely	Date:	June 6, 2002
From:	Larry Toedtli, P.E. Kerensa Fromherz, P.E.	TG:	00332.03
cc:	Bill Hoffman, Issaquah MDRT		
Subject:	Issaquah Highlands – Microsoft Construction Traffic		

The Transpo Group previously prepared an analysis of potential traffic impacts on Black Nugget Road associated with construction of the Microsoft Campus at Issaquah Highlands. That analysis was based on up to 245 construction workers onsite. The analysis assumed a worst-case condition that all construction traffic would use Black Nugget Road. This technical memorandum updates the analysis based on the following:

- An increase in the potential number of construction workers to 350; and
- Assumption that most of the outbound construction-related traffic would use the interim, south-to-west on-ramp between the South SPAR and I-90.

As with the prior analyses, a conservative assumption is that each construction worker would make four trips per day (inbound in the morning, outbound for lunch, inbound from lunch, outbound after work). This assumes that all workers would leave the site for lunch and no carpooling would occur (even for lunch). This would result in 1,400 daily trips for construction workers (700 inbound, 700 outbound). An additional 152 daily trips would result from the 76 delivery trucks (76 inbound, 76 outbound).

Several assumptions are made regarding the anticipated travel routes for the construction traffic. Some outbound traffic is assumed to use Black Nugget Road to connect to the Plateau or other areas north of the site. For analysis purposes, we have assumed that up to 25 percent of the outbound trips by the 350 construction workers would use Black Nugget Road with the rest using the South SPAR to I-90. Delivery trucks would use Black Nugget Road to enter the site (due to the steep grade on 229th Avenue) and would be directed to use the South SPAR to exit the site. The anticipated trip routes to and from the site based on these assumptions and conversations with the City of Issaquah and are summarized below:

Construction Workers:

- 75% of inbound workers will arrive via 229th Ave
- 25% of inbound workers will arrive via Black Nugget Rd
- 75% of outbound workers will exit via the south SPAR to I-90 ramp
- 25% of outbound workers will exit via Black Nugget Rd

Delivery Trucks:

- 100% of inbound delivery trucks will use Black Nugget Rd
- 100% of outbound delivery trucks will use the south SPAR to I-90 ramp

Based on these assumptions and distributions, construction traffic would result in 426 vehicles per day (vpd) on Black Nugget Road. This total is developed as follows:

Construction workers – inbound (25%)	175
Construction workers – outbound (25%)	175
Delivery trucks – inbound (100%)	76
Delivery trucks – outbound (0%)	0
Total	**426**

The 426-vpd traffic load on Black Nugget Road is significantly lower than the estimated full site occupancy traffic that is allowed under the currently approved Phase 1 development level. This would result in correspondingly fewer impacts on traffic operations at study area intersections previously analyzed for Phase 1 or Phase 1B based on full occupancy of the office space. Therefore, the impacts of construction traffic will be lower than those analyzed for buildout of Phase 1 without the interim I-90 on-ramp.

Please contact Kefensa Fromherz or Larry Toedtli if you have any questions or require additional information.

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