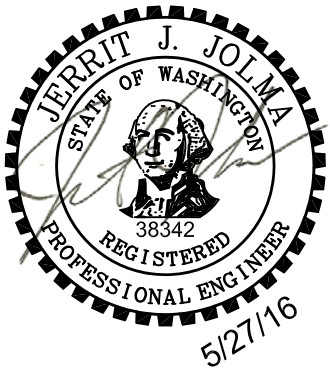
ADDENDUM TO THE

PRELIMINARY TIR

Rio Vista

Vicinity NE 143rd Place and 272nd Place NE
Duvall, WA
Parcel Nos. **782580-0150 thru -0180**

Prepared for:
Rio Vista Investments, LLC
PO Box 1282
Bellevue, WA 98009



Prepared by:

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May, 2016 **REID-004**

Introduction

This Addendum to the Preliminary TIR has been prepared to support directing onsite developed flows westerly along NE 143rd Place rather than to an existing ditch flowing from the site northerly to NE 144th Place. Calculations indicate the existing ditch does not have sufficient capacity to pass onsite flows and must be enlarged to accommodate new flows. At this time, an agreement is not able to be reached with the property owner north of the site to allow the work to enlarge the ditch. If an agreement is achieved in the future with the property owner, then an improved ditch could be utilized.

The detention vault outflow, except the flow routed to the onsite wetland necessary to maintain hydrology, will be routed to the existing drainage system located on the north side of NE 143rd Place. The following revised **SECTION 2 – CONDITIONS AND REQUIREMENTS SUMMARY**, shall replace **SECTION 2** of the Rio Vista Preliminary Technical Information Report. In addition, the calculations completed in support of Core Requirement #4 constitute a Level 3 downstream analysis and should replace pertinent components of the Level 1 downstream analysis in the original report.

SECTION 2
CONDITIONS AND REQUIREMENTS SUMMARY

Core Requirement #1: Discharge at the Natural Location

The southeast portion of the project currently discharges to the NE 143rd Place conveyance system, and therefore would continue to discharge at its natural location.

The portion of the project site that is north of NE 143rd Place currently discharges to the onsite wetland, then northerly through a series of pipes, culverts an open channels to the Snoqualmie River ("northerly route"). Although NE 143rd Place is not the natural discharge point of this portion of the site, a point of compliance exists at the Snoqualmie River east of SR 203 where the NE 143rd Place and northerly route converge.

Additionally, rerouting a portion of the flow that is currently tributary to the northerly route conveyance system will help ameliorate existing and future drainage problems associated with the existing system.

A portion of the detained flows will be routed to the onsite wetland as required to maintain wetland hydrology, functions and values. The flow amount routed to the wetland is described in a report by Ed McCarthy dated February 16, 2016.

Core Requirement #2: Offsite Analysis

A Level 1 offsite analysis of the 143rd Place conveyance system was previously prepared and is contained in the Preliminary TIR dated April, 2015.

A downstream field survey of the NE 143rd Place conveyance system from the Site to SR 203 was performed on April 15, 2016, to support a Level 3 downstream analysis. This survey identified various drainage elements, including pipes, catch basins, ditches, elevations and material types. The data collected from this survey was utilized to prepare an inventory of the downstream conveyance system between the Site and SR 203. Please see the attached Offsite Ditch Survey Map by ESM. An inventory of the NE 143rd Place downstream system is included with **Core Requirement #4: Conveyance System**.

Core Requirement #3: Flow Control

The proposed Level 2 Flow Control design for the project will remain unchanged.

Core Requirement #4: Conveyance System

The onsite portion of the proposed drainage system will be discussed in Section 5 of the final TIR and provide adequate capacity to convey the 25-year storm without overtopping.

A preliminary offsite conveyance analysis was performed to verify the capacity and identify capacity deficiencies within the existing NE 143rd Place system. The analysis was performed by identifying all upstream and downstream drainage basins tributary to the system, creating runoff models for each basin, verifying peak conveyance capacities for each identified element in the downstream system, and creation of a backwater model for elements of the system that are near, or potentially over capacity.

From the survey, an inventory of the identified components of the drainage system was created. Each element was assigned a number and then a peak capacity for that element was calculated utilizing Manning's Equation. Please see the attached **Figure 1: Downstream Conveyance and Basin Map**, and **Table 1: Downstream Conveyance Inventory** below.

Table 1: Downstream Conveyance Inventory

ELEMENT NO.	TYPE	SIZE	Material	SLOPE	Peak CAPACITY
1	Ditch	*	Rock	8.9%	36.8
2	Culvert	24"	CMP	4.5%	26
3	Ditch	*	Rock	10.3%	39.54
4	Culvert	24	RCP	6.4%	62
5	Ditch	*	Rock	8.1%	35.07
6	Pipe	15"	CPP	2.2%	10.38
7	Pipe	15"	CPP	8.6%	20.52
8	Pipe	15"	CPP	11.4%	23.63
9	Pipe	15"	CPP	17.3%	29.11
10	Ditch	*	Rock	15.0%	47.72
11	Culvert	24"	RCP	10.7%	80.16
12	Ditch	*	Rock	13.0%	44.43
13	Culvert	24"	RCP	6.5%	62.48
14	Ditch	*	Rock	9.8%	38.57
15	Pipe	24"	CMP	5.8%	29.51
16	Pipe	24"	CMP	7.1%	32.65
17	Ditch	*	Rock	4.7%	26.71

*Ditches are assumed to be rock lined with a 2' wide bottom, depth of 1', and side slopes of 2:1
Pipe capacities were calculated utilizing Manning's Equation for full pipe with an N=0.011 for corrugated plastic pipe ("CPP"), N=0.12 for reinforced concrete pipe ("RCP"), and N=0.024 for corrugated metal pipe ("CMP").

All drainage basins tributary to the system where identified utilizing field survey, City asbuilts, aerial photos and on-the-ground observations. The basin areas are depicted on Figure 1 as Basins 1-8 and consist of approximately 45.5 acres.

From the basin areas, the impervious/pervious fractions for each basin were calculated utilizing KCSWDM Table 3.2.2.D, which relates existing dwelling units per gross acre to impervious surface percentage. The actual impervious surface amounts calculated for the proposed Rio Vista development was utilized in this inventory for Basins 5 and 6. Till soils were utilized per the geotechnical recommendations. Please see the **Table 2: Basin Land Coverages** (below).

Table 2: Basin Land Coverages

		KC - Table 3.2.2.D		Basin	Pervious Areas (Till)		
Basin	Area (AC)	Dwelling/Gross (AC)	Average % Imp.	Impervious (AC)	Grass (AC)	Pasture (AC)	Forest (AC)
1	5.71	1	15%	0.86		4.85	
2	5	6	52%	2.60	2.40		
3	5.25	6	52%	2.73	2.52		
4	3.5	1	15%	0.53	2.98		
5	9.31	Per Design	Per Design	7.39	1.92		
6	1.68	Per Design	Per Design	1.28	0.4		
7	2.59	1	15%	0.39			2.20
8	12.46	2.5	30%	3.74	8.72		

Note: In Existing Condtions Basin 5 is not tributary to the downstream system, and Basin 6 is 1.68 ac Till Forest.

Runoff from the upstream and downstream basins was then calculated using KCRTS runoff time series with 15-minute time steps, the basin areas and land coverages calculated in Table 2. The KCRTS output is attached to this Addendum. Flow from the basins upstream and downstream of the site is assumed to be undetained and therefore likely overestimates the flows from the two existing developments (Basin 2 and 3) that have provided onsite detention.

The detention vault outflow rates (see Section 5 of the Preliminary TIR) from Rio Vista were used in the hydraulic models. **Table 3: Basin Flowrates**, summarizes the 10, 25, 50, and 100-year runoff for each basin.

Table 3: Basin Flowrates

			KCRTS RUNOFF RATES			
BASIN	AREA (AC)		10 YR	25 YR	50 YR	100 YR
1	5.71		1.17	1.26	2.1	2.52
2	5		3.03	3.05	4.14	4.69
3	5.25		3.18	3.2	4.35	4.93
4	3.5		1.33	1.73	2.17	2.39
5	9.31		0.512	0.595	2.202	3.005
6	1.68					
7	2.59		0.352	0.377	0.593	0.7
8	12.46		5.86	6.73	8.76	9.78

Note: Basin 5 and 6 runoff rates are combined flowrates exiting the detention vaults for the Rio Vista developed condition. All others are undetained 15-minute runoff rates.

The flowrates depicted in Table 3 where applied where tributary to each conveyance element (Table 1) to compare the calculated capacity for that element to the total tributary flowrate for each return period. Any element that was over capacity was then identified along with the return period. **Table 4: Capacity Analysis** summarizes the results of that analysis.

Table 4: Capacity Analysis

ELEMENT NO.	Peak CAPACITY	Trib. Basins	DEVELOPED FLOWS TRIBUTARY TO ELEMENT (cfs) 10-YR	25-YR	50-YR	100-YR	OVER CAPACITY Y/N	RETURN PERIOD
1	36.8	1-8	15.434	16.942	24.315	28.015	N	
2	26	1-8	15.434	16.942	24.315	28.015	Y	100
3	39.54	1-8	15.434	16.942	24.315	28.015	N	
4	62	1-8	15.434	16.942	24.315	28.015	N	
5	35.07	1-8	15.434	16.942	24.315	28.015	N	
6	10.38	2-8	14.264	15.682	22.215	25.495	Y	10
7	20.52	3-8	11.234	12.632	18.075	20.805	Y	100
8	23.63	3-8	11.234	12.632	18.075	20.805	N	
9	29.11	4-8	8.054	9.432	13.725	15.875	N	
10	47.72	4-8	8.054	9.432	13.725	15.875	N	
11	80.16	4-8	8.054	9.432	13.725	15.875	N	
12	44.43	4-8	8.054	9.432	13.725	15.875	N	
13	62.48	4-8	8.054	9.432	13.725	15.875	N	
14	38.57	4-8	8.054	9.432	13.725	15.875	N	
15	29.51	4-8	8.054	9.432	13.725	15.875	N	
16	32.65	4-8	8.054	9.432	13.725	15.875	N	
17	26.71	4-8	8.054	9.432	13.725	15.875	N	

Although the Core Requirement 2 of the 2009 KCSWDM does not specifically address what return period should be used to evaluate existing offsite conveyance systems, the 10-year storm was utilized in accordance with Section 1.2.4.2 of the 2009 KCSWDM. This section of the manual specifies that existing onsite conveyance systems must be analyzed and shown to have sufficient capacity to convey and contain (at minimum) the 10-year peak flow assuming developed conditions for onsite tributary areas and existing conditions for any offsite tributary areas.

Based on the capacity analysis, all identified downstream elements were found to have adequate capacity to convey the 10-year event except Element 6. Therefore, a backwater model was prepared to further investigate the capacity of Elements 6-9, which is a newly constructed tight line consisting of 15-inch CPP and catch basins. This portion of the downstream system is located in the NE 143rd Place roadway and was constructed as part of the new subdivisions between 266th Place NE and 3rd Avenue NE.

A backwater model was created for Elements 6-9 using Hydraflow Storm Sewers, which uses the energy-based Standard Step method to calculate hydraulic profiles. KCRTS 10-year runoff rates and connection points were input into the model (per **Table 4: Capacity Analysis**) as directly injected flows and a backwater profile was created, please see the attached model output.

The model results show that the existing 15-inch CPP has the capacity to convey the required 10-year basin runoff, but will surcharge Element 6 slightly. The model also shows that each of the elements in the 15-inch run (Elements 6-9) are under inlet control,

but do not overtop the existing catch basins. Please see the attached model results and backwater profile.

Recommendations

The analysis indicates the existing stormwater conveyance system along the north side of NE 143rd Place is capable of conveying the existing 10 year flows tributary to the system, as well as the new flow that will be routed to the system from Rio Vista, without overtopping any portion of the existing system during a 10-year rainfall event.

As indicated in the downstream analysis, maintenance of the ditch along the north side of NE 143rd Place should be performed to verify that all portions of the ditch are rocked and have a minimum width of 2-feet, depth of 1-foot, with side slopes of 2:1. Due to heavy weed, blackberry and other vegetation growth, not all portions of the ditch were visible at the time the field investigation was conducted.

Core Requirement #5: Erosion and Sedimentation Control

No changes required.

Core Requirement #6: Maintenance and Operations

No changes required.

Core Requirement #7: Financial Guarantees and Liability

No changes required.

Core Requirement #8: Water Quality

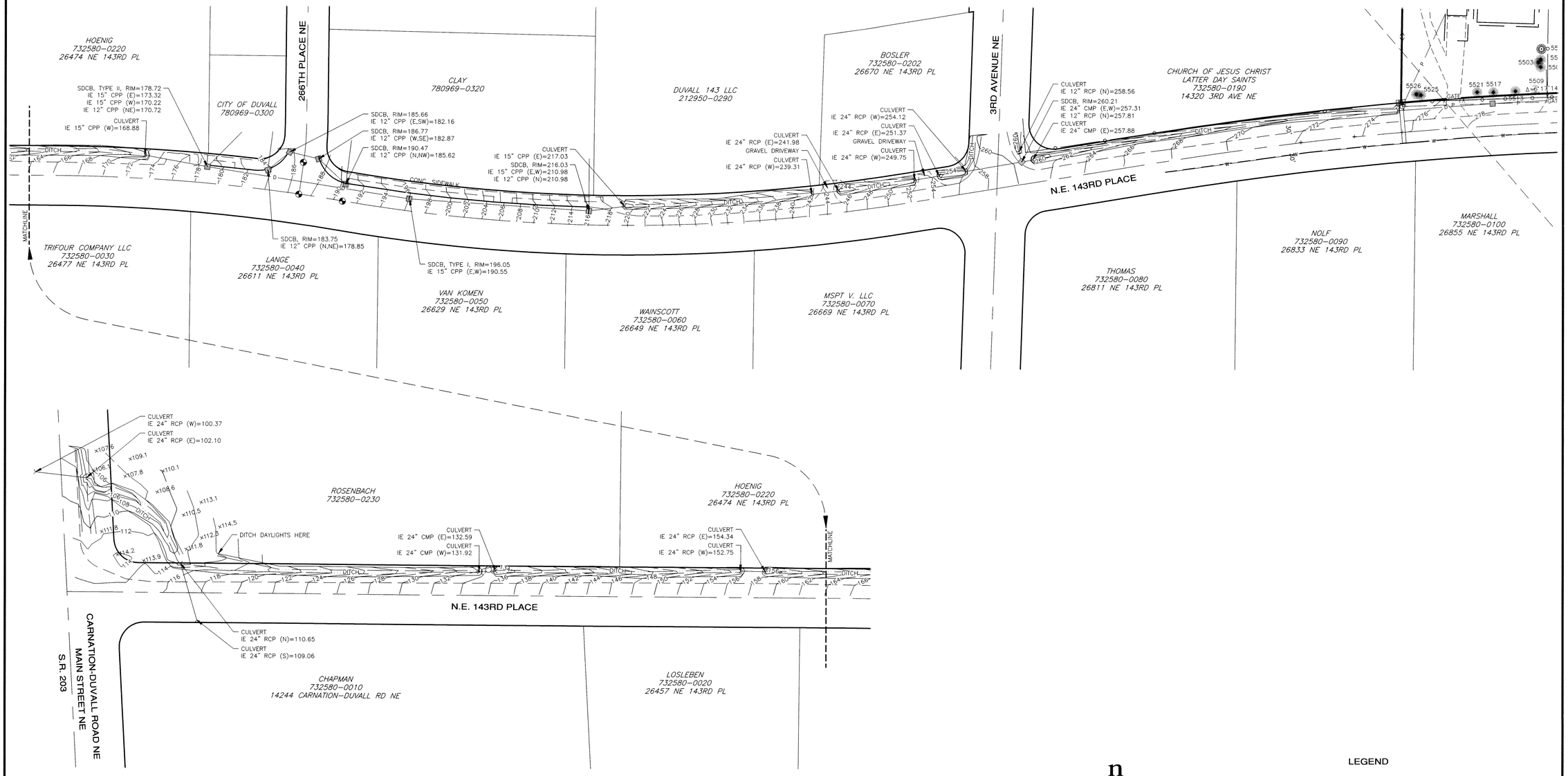
No changes required.

SPECIAL REQUIREMENTS

No changes required.

ATTACHMENTS

A PORTION OF THE NE 1/4 OF SECTION 24, TWP. 26 N., RGE 6 E., W.M., KING COUNTY, WASHINGTON



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SCALE: 1" = 50'

50 25 0 50 100

LEGEND

- GATE
- STORM DRAIN CATCH BASIN
- STORM PIPE INLET/OUTLET
- FIRE HYDRANT
- FOUND CASED MONUMENT
- x1234.5 SPOT ELEVATION
- 536 EXISTING GROUND CONTOURS
- FENCE WROUGHT IRON
- D STORM
- ASPHALT
- CONCRETE (CONC.)
- GRAVEL

REVISIONS		
NO.	DESCRIPTION/DATE	BY

4-15-16

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Land Surveying
Project Management
Land Planning
Landscape Architecture

RIO VISTA INVESTMENTS LLC

RIO VISTA RANCHETTES

OFFSITE DITCH SURVEY

KING COUNTY WASHINGTON

JOB NO.:	1155-003-008
DWG. NAME:	TOPO-08
DESIGNED BY:	
DRAWN BY:	JDC
CHECKED BY:	RAF
DATE:	04-15-2016
DATE OF PRINT:	

1 OF 1 SHEETS

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SEC. 24, TWP. 26N, RGE. 5E, W.M.

GRAPHIC SCALE

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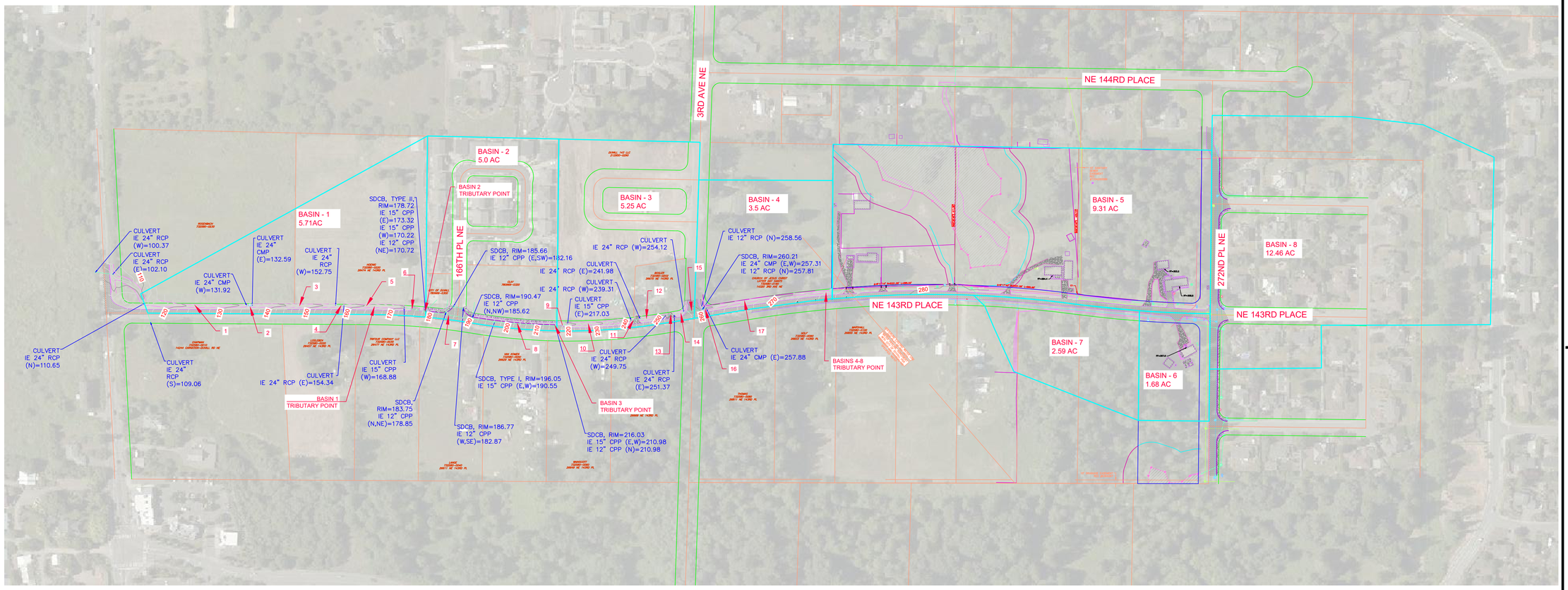

NO.	DATE	REVISION	BY	CK.

DESIGN GROUP
JON W. NELSON, P.E.
PROJECT MANAGER:
DESIGNED:
CADD:
CHECKED:
DATE:
BASIN/S:
FILE NAME:

NE 143rd PLACE
CONVEYANCE AND BASIN MAP

RIO VISTA INVESTMENTS, LLC

RIO VISTA

CITY OF DUVALL WASHINGTON

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SHEET NUMBER 1 OF 1

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basin1

Flow Frequency Analysis

Time Series File:basin1.tsf

Project Location:Landsburg

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
0.685	7	2/09/01	3:00	2.52	1	100.00	0.990
0.443	8	5/06/02	7:15	1.26	2	25.00	0.960
1.17	3	6/25/03	2:15	1.17	3	10.00	0.900
0.946	5	8/25/04	23:30	1.11	4	5.00	0.800
1.11	4	1/05/05	9:30	0.946	5	3.00	0.667
1.26	2	10/22/05	16:15	0.842	6	2.00	0.500
0.842	6	11/21/06	8:00	0.685	7	1.30	0.231
2.52	1	1/09/08	7:30	0.443	8	1.10	0.091
Computed Peaks				2.10		50.00	0.980

basin2

Flow Frequency Analysis

Time Series File:basin2.tsf

Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
1.33	7	10/04/00 20:15	4.69	1	100.00	0.990
1.32	8	5/06/02 7:15	3.05	2	25.00	0.960
2.75	4	9/10/03 13:45	3.03	3	10.00	0.900
3.05	2	8/25/04 23:30	2.75	4	5.00	0.800
1.87	6	9/10/05 16:45	2.10	5	3.00	0.667
3.03	3	10/22/05 16:15	1.87	6	2.00	0.500
2.10	5	11/21/06 8:00	1.33	7	1.30	0.231
4.69	1	1/09/08 7:30	1.32	8	1.10	0.091
Computed Peaks			4.14		50.00	0.980

basin3

Flow Frequency Analysis

Time Series File:basin3.tsf

Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
1.40	7	10/04/00 20:15	4.93	1	100.00	0.990
1.39	8	5/06/02 7:15	3.20	2	25.00	0.960
2.89	4	9/10/03 13:45	3.18	3	10.00	0.900
3.20	2	8/25/04 23:30	2.89	4	5.00	0.800
1.96	6	9/10/05 16:45	2.21	5	3.00	0.667
3.18	3	10/22/05 16:15	1.96	6	2.00	0.500
2.21	5	11/21/06 8:00	1.40	7	1.30	0.231
4.93	1	1/09/08 7:30	1.39	8	1.10	0.091
Computed Peaks			4.35		50.00	0.980

basin4

Flow Frequency Analysis

Time Series File:basin4.tsf

Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.687	7	2/08/01 19:00	2.39	1	100.00	0.990
0.418	8	5/06/02 7:15	1.73	2	25.00	0.960
1.18	4	6/25/03 2:15	1.33	3	10.00	0.900
1.73	2	8/25/04 23:30	1.18	4	5.00	0.800
0.709	6	9/10/05 16:45	1.02	5	3.00	0.667
1.33	3	10/22/05 16:15	0.709	6	2.00	0.500
1.02	5	11/21/06 8:15	0.687	7	1.30	0.231
2.39	1	1/09/08 7:30	0.418	8	1.10	0.091
Computed Peaks			2.17		50.00	0.980

basin7

Flow Frequency Analysis

Time Series File:basin7.tsf

Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.279	6	2/09/01 3:00	0.700	1	100.00	0.990
0.180	8	5/06/02 7:15	0.377	2	25.00	0.960
0.377	2	6/25/03 2:15	0.352	3	10.00	0.900
0.298	5	8/25/04 23:30	0.305	4	5.00	0.800
0.239	7	9/10/05 16:45	0.298	5	3.00	0.667
0.352	3	10/22/05 16:15	0.279	6	2.00	0.500
0.305	4	11/21/06 8:00	0.239	7	1.30	0.231
0.700	1	1/09/08 7:30	0.180	8	1.10	0.091
Computed Peaks			0.593		50.00	0.980

basin8

Flow Frequency Analysis

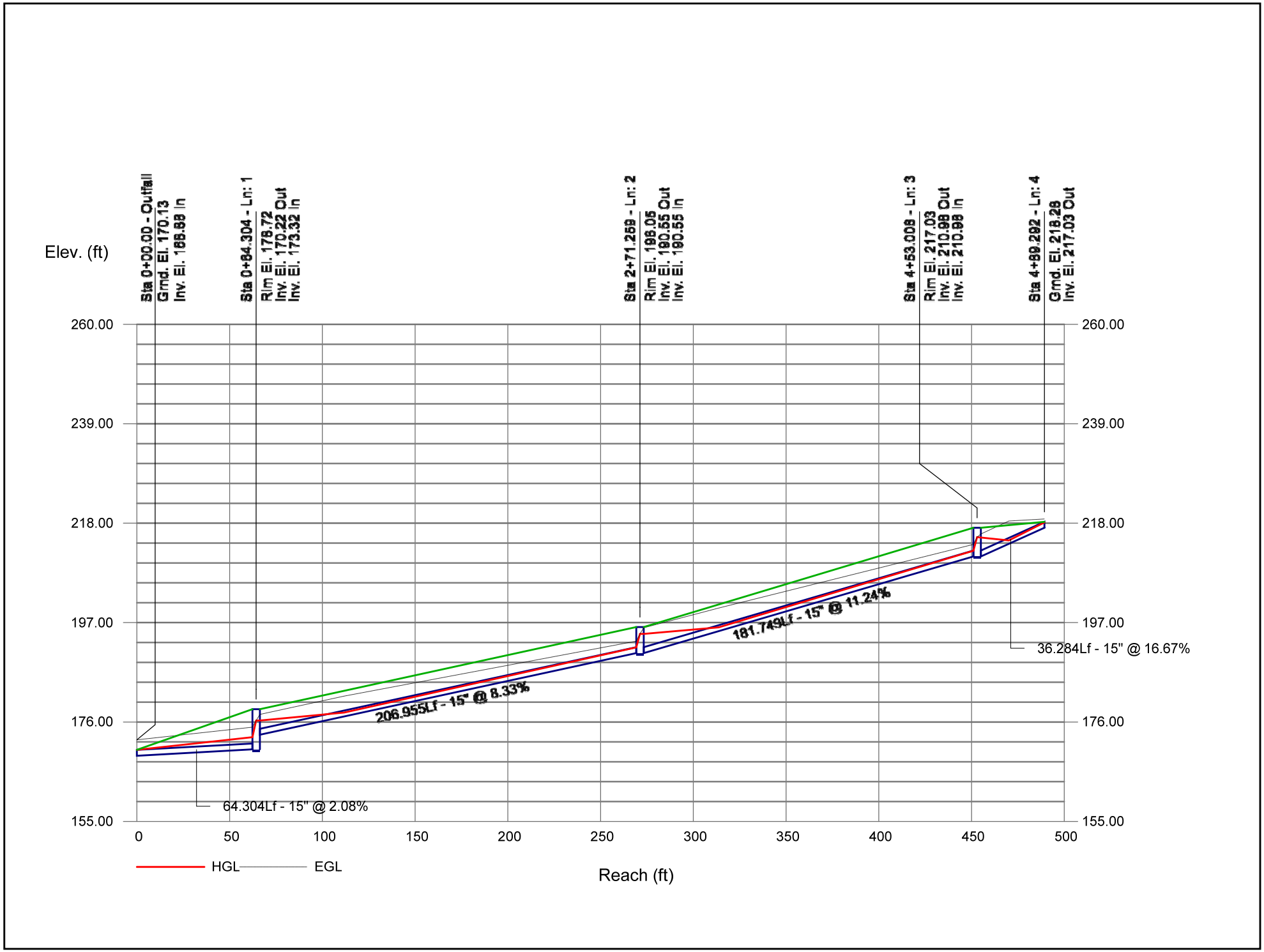
Time Series File:basin8.tsf

Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
2.78	7	2/08/01 19:00	9.78	1	100.00	0.990
2.22	8	5/06/02 7:15	6.73	2	25.00	0.960
4.85	4	6/25/03 2:15	5.86	3	10.00	0.900
6.73	2	8/25/04 23:30	4.85	4	5.00	0.800
3.38	6	9/10/05 16:45	4.25	5	3.00	0.667
5.86	3	10/22/05 16:15	3.38	6	2.00	0.500
4.25	5	11/21/06 8:00	2.78	7	1.30	0.231
9.78	1	1/09/08 7:30	2.22	8	1.10	0.091
Computed Peaks			8.76		50.00	0.980

Storm Sewer Profile

Proj. file: devsystem.stm



Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	64.304	10.387	Genr	3.03	0.00	0.00	0.0	168.88	2.08	170.22	15	Cir	0.012	0.50	178.72	
2	1	206.955	-1.553	Genr	0.00	0.00	0.00	0.0	173.32	8.33	190.55	15	Cir	0.012	0.50	196.05	
3	2	181.749	-5.157	Genr	3.18	0.00	0.00	0.0	190.55	11.24	210.98	15	Cir	0.012	0.50	217.03	
4	3	36.284	-10.851	None	8.05	0.00	0.00	0.0	210.98	16.67	217.03	15	Cir	0.012	1.00	218.28	

Project File: devsystem.stm | Number of lines: 4 | Date: 5/23/2016

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	64.304	0.00	0.00	0.00	0.00	0.00	0.0	0.8	0.0	14.26	10.10	11.62	15	2.08	168.88	170.22	170.13	172.80	170.13	178.72	
2	1	206.955	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	11.23	20.19	9.20	15	8.33	173.32	190.55	176.31	191.76	178.72	196.05	
3	2	181.749	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	11.23	23.45	9.20	15	11.24	190.55	210.98	194.62	212.19	196.05	217.03	
4	3	36.284	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	8.05	28.57	6.76	15	16.67	210.98	217.03	215.05	218.15	217.03	218.28	

Project File: devsystem.stm | Number of lines: 4 | Run Date: 5/23/2016

NOTES:Intensity = 69.87 / (Inlet time + 13.10) ^ 0.87; Return period =Yrs. 2 ; c = cir e = ellip b = box