Sanitary Sewer Study

Lot 7 and Tract C
Streets of West Pryor
Lee's Summit, MO

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INTRODUCTION

This sanitary sewer study is being prepared to address the proposed development on Lot 7 and Tract C of the Streets of West Pryor. Kaw Valley Engineering prepared a study in September of 2018 to address the additional flow as a result of the Streets of West Pryor development. This study addresses the increase in flow associated with the increased density proposed for Lot 7 and Tract C on the west end of the Streets of West Pryor. This study will use the same methodology of the original study and revise the charts in the KVE study based on the increased density. There are 2 basins that this affects. The west basin sanitary sewer system which begins on Autumn Lane south of Lowenstein with an outfall to the west. Also the south basin system which begins at the east end of the park on Lowenstein and continues to the south. These 2 basins are depicted in Appendix A.

PROPOSED DEVELOPMENT

The revised preliminary development plan for Lot 7 and Tract C of the Streets of West Pryor shows constructing an 83 unit townhome development on tract C. The original plan showed that this area would be comprised of a 29 lot single family development. On Lot 7 we are proposing to construct a 184 unit apartment complex as well as an 88 room hotel. Originally the plan was for a 166 unit senior housing facility with the hotel lot being part of a shared amenity area. As such there will be an increase in the potential sanitary sewer flow. The additional flow is summarized in Table B1 shown in Appendix B. The information shown in black is data taken from the original study for Streets of West Pryor with the information in red being the densities planned for the revised preliminary development plan for Lot 7 and Tract C.

PROPOSED FLOW TO DOWNSTREAM SYSTEM

To determine the effect on the downstream system as a result of the increased density the new flow data was applied to the downstream pipe network. This additional flow was then analyzed to see what effect it had on the existing pipe network and what improvements were warranted. Tables B2 and B3, shown in Appendix B, illustrate the increased flow in the south and the west pipe network.

SOUTH SYSTEM

In the original study the senior housing facility was shown to drain to the south basin. The revised plan shows the 184 unit apartment complex also draining to the south basin. The slight increase in density results in an increase of 0.02 cfs draining to the south basin. To determine if the downstream network had excess capacity to handle the increased flow we compared the

new flow values to the pipe capacity of each line in the system. After comparison no lines were seen to be over capacity. As such the existing pipe network can handle the increased flow.

WEST SYSTEM

Per the original Streets of West Pryor development plan the only new development that was proposed to drain to the west system were the 29 residential lots. The revised plan for Lot & and Tract C proposes to have the 83 townhomes along with the 88 unit hotel drain to the west basin. This increased density results in an increase of 0.06 cfs to the west basin over what was originally proposed.

As indicated in the original report there were capacity issues in the downstream reaches of the existing system. This resulted in the potential surcharging of the system. To determine the effect the additional flow would have we input a portion of the existing system into Stormwater Studio by Hydrology Studios. The results of this analysis is shown in Appendix C.

As illustrated in the original report, 3 of the downstream lines were being surcharged. Lines 5, 6 and 7 show surcharges above the crown of the pipe of 1.78 ft. to 3.45 ft. With the increase in flow line 8 is now showing a surcharge with lines 5, 6 and 7 showing a greater surcharge. These surcharges are between 3.33 ft. and 4.02 ft. above pipe crown. However, in no case is the surcharge above the manhole rim elevation.

As indicated in the original report to eliminate the surcharge would require upsizing line 5 from 8” to 10”. This is still the case and would eliminate any surcharge

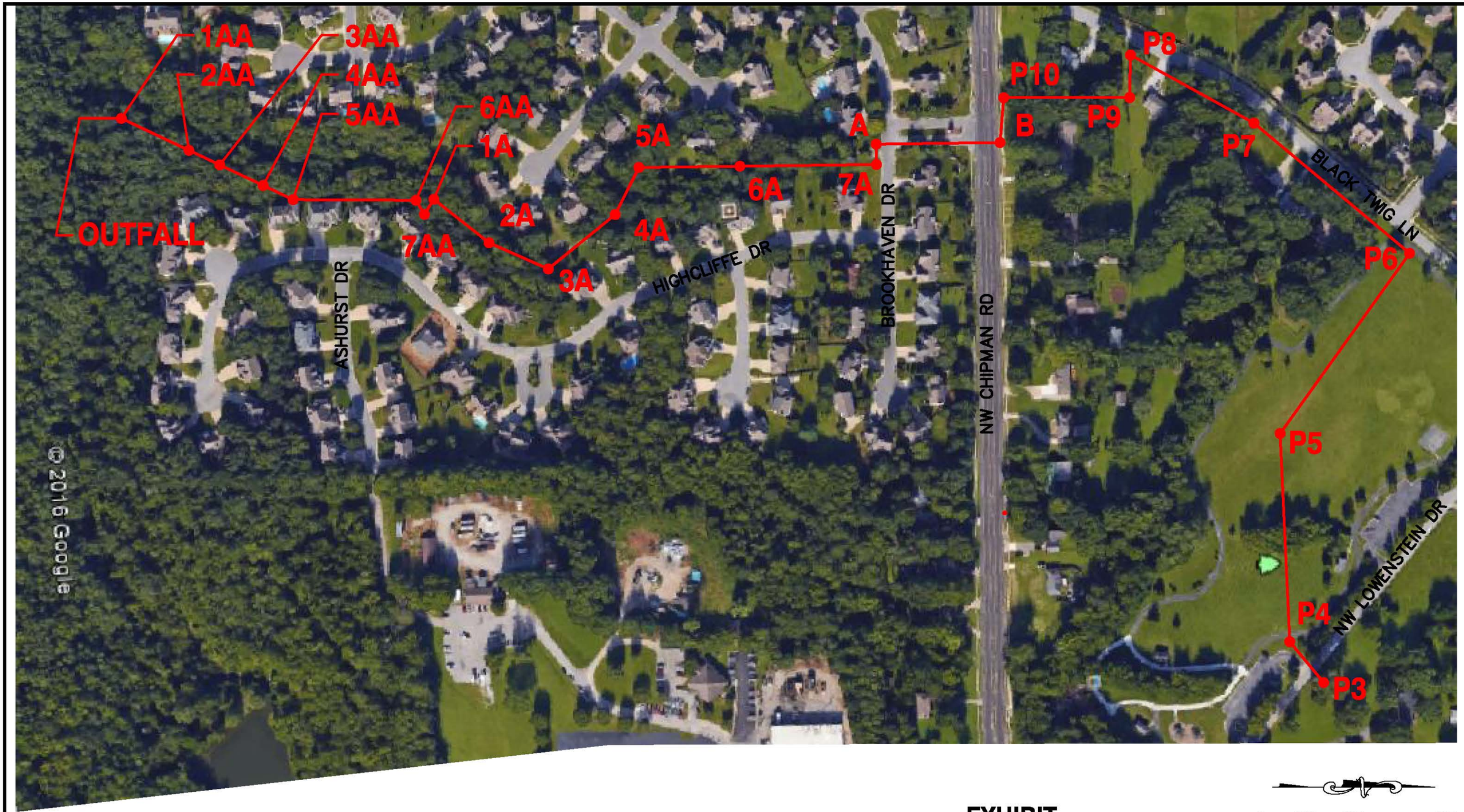
CONCLUSION

Based on the above discussion the affect the proposed increase in sanitary sewer flow to the south and west basin was analyzed. As shown, the south system will continue to operate as designed with minimal surcharge potential.

The increased flow to the west system will increase the potential surcharge depths in a section of the downstream line. However, in no case is the surcharge depth ever above the rim of any existing manhole rim. As discussed, this surcharge could be eliminated if one section of line is increased in size.

Appendix A

- South System Layout
- West System Layout



EXHIBIT

MAIN EXTENSION AND DOWNSTREAM SYSTEM, SOUTH SYSTEM

0 100 200 400

SCALE: 1" = 200'

EXHIBIT

MAIN EXTENSION AND DOWNSTREAM SYSTEM, WEST SYSTEM

Appendix B

- Table B1 – Peak Flow Calculation for No-Residential and Multi-Family EDU
- Table B2 – Total Sewer Flow Calculation For South System
- Table B3 – Total Sewer Flow Calculation For West System

Table B1
Peak Base Flow Calculation for Non-Residential and Multi-Family EDU

Lot ID	Use Type	EDU per Unit	Unit of Measure	# of Units	# of EDU	Total EDU per Sewer Zone	Total Peak Base Flow (at 300 gpd per EDU) per Zone	Sewered Acres in Zone	Peak Base Flow Per Acre Sewered in Zone
Zone A - to Bog's Hollow System (East)									
8	Restaurant	3.5	1000 sf	7500	26.3				
9	Restaurant	3.5	1000 sf	7500	26.3				
10	Restaurant (2 Tenants)	3.5	1000 sf	12300	43.1				
11	Hotel (80 Room)	0.3	room	80	24.0				
12	Hotel (105 rooms)	0.3	room	105	31.5				
						151.1	45,315	15.0	3,017
		will use the higher factor from original study for calculation=						***15.0***	***3244***
Zone B - Direct Contribution to System South									
na	Detention/Water Feature	0	n/a	0	-				
1	Restaurant (Sit Down)	3.5	1000 sf	6500	22.8				
2	Restaurant (Sit Down)	3.5	1000 sf	6500	22.8				
5	Grocery	0.2	1000 sf	63119	12.6				
4	Retail	0.2	1000 sf	6500	1.3				
3	Restaurant w/Drive Thru	1.6	1000 sf	5500	8.8				
7	Apartments w/Club House	1	Apt	251	251.0				
part of 7	Retail	0.2	1000 sf	10000	2.0				
part of 7	Restaurant	3.5	1000 sf	5000	17.5				
13	Ball Court	0	n/a	0	-				
Prop. Lot 2	Apartments	1	Apt	184	184				
						522.7	156,810	31.1	5,042
Zone C - to System West									
Prop. Lot 1	Townhomes	1	Townhome	83	83			7.8	1500
Prop. Lot 3	Hotel (88 Room)	0.3	Room	88	26.4	109.4	32,820	11	2,984
Zone D - Addition for Homes on Black Twig to City Sewers, to System South									
Existing Lots	Single Family Residential							4.1	1500

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Table B2
Total Sewer Flow Calculation for Streets of West Pryor Systems

South System

Line	Peak base flow (gpd/ac)	Res./Com. Peak infil. (gpd/ac)	Drainage Area (acres)	Cuml Drainage Area (acres)	Peak Base + Infiltration (gpd)	Peak Base + Infiltration (cfs)	(a) Cuml Peak Base +Infill (cfs)	K (Incr)	K*A Incr	Cuml K*A	Tc (min)	Rainfall Intensity (i) (50 yr)	(b) Cuml Peak inflow, Q = kAi (cfs)	(a+b) Cuml Total Peak Flow = Base + Infil + Inflow (cfs)
South System (Zones B and D) (using K=0.002 for both new and existing areas)														
P3 - P6 (Zone B)	5042	250	31.1	31.1	164,581	0.255	0.255	**0.002**	0.062	0.062	44	4.18	0.26	0.52
P6 - 10 (Zone D)	1500	500	4.1	35.2	8,200	0.013	0.268	**0.002**	0.008	0.070	46	4.12	0.29	0.56
B-A	1500	500	7.05	42.3	14,100	0.022	0.29	**0.002**	0.014	0.085	48	4.01	0.34	0.63
A-7A	1500	500	2.95	45.2	5,900	0.009	0.299	**0.002**	0.006	0.090	49	3.95	0.36	0.66
7A-6A	1500	500	5.57	50.8	11,140	0.017	0.316	**0.002**	0.011	0.102	50	3.83	0.39	0.71
6A-5A	1500	500	5.53	56.3	11,060	0.017	0.333	**0.002**	0.011	0.113	51	3.78	0.43	0.76
5A-4A	1500	500	5.09	61.4	10,180	0.016	0.349	**0.002**	0.010	0.123	52	3.72	0.46	0.81
4A-3A	1500	500	0.33	61.7	660	0.001	0.350	**0.002**	0.001	0.123	53	3.72	0.46	0.81
3A-2A	1500	500	0.32	62.0	640	0.001	0.351	**0.002**	0.001	0.124	53	3.72	0.46	0.81
2A-1A	1500	500	0.42	62.5	840	0.001	0.352	**0.002**	0.001	0.125	53	3.72	0.46	0.81
1A-7AA	1500	500	2.81	65.3	5,620	0.009	0.361	**0.002**	0.006	0.131	53	3.66	0.48	0.84
7AA-6AA	1500	500		65.3			0.361	**0.002**	-	0.131	53	3.66	0.48	0.84
6AA-5AA	1500	500	9.78	75.1	19,560	0.030	0.391	**0.002**	0.020	0.150	55	3.55	0.53	0.92
5AA-ADD	1500	500		75.1			0.391	**0.002**	-	0.150	55	3.55	0.53	0.92
ADD-4AA	1500	500	9.55	84.6	19,100	0.030	0.421	**0.002**	0.019	0.169	57	3.49	0.59	1.01
4AA-3AA	1500	500		84.6			0.421	**0.002**	-	0.169	57	3.49	0.59	1.01
3AA-2AA	1500	500	7.36	92.0	14,720	0.023	0.444	**0.002**	0.015	0.184	58	3.37	0.62	1.06
2AA-1AA	1500	500		92.0			0.444		-	0.184	58	3.37	0.62	1.06

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Table B3
Total Sewer Flow Calculation for Streets of West Pryor Systems

West System, for K=0.003 in most areas

Line	Peak base flow (gpd/ac)	Res./Com. Peak infil. (gpd/ac)	Drainage Area (acres)	Cuml Drainage Area (acres)	Peak Base + Infiltration (gpd)	Peak Base + Infiltration (cfs)	(a) Cuml Peak Base +Infill (cfs)	K (Incr)	K*A Incr	Cuml K*A	Tc (min)	Rainfall Intensity (i) (50 yr)	(b) Cuml Peak inflow, Q = kAi (cfs)	(a+b) Cuml Total Peak Flow = Base + Infil + Inflow (cfs)
West System (Zones C) (Base Scenario using K=0.002 for new project, K=0.0030 for existing residential areas served with PVC, and K=0.006 the lowest reach)														
B2(Zone C) to B-1	2984	250	11.0	11.0	35,574	0.055	0.055	0.002	0.022	0.022	31	4.92	0.11	0.17
B-1 to 2-6	1500	500	8.00	19.0	16,000	0.025	0.080	**0.003**	0.024	0.046	37	4.58	0.21	0.29
2-6 to 2-3	1500	500	10.00	29.0	20,000	0.031	0.111	**0.003**	0.030	0.076	42	4.29	0.33	0.44
2-3 to 2-1	1500	500	8.00	37.0	16,000	0.025	0.136	**0.003**	0.024	0.100	45	4.12	0.41	0.55
2-1 to 1-11	1500	500	5.00	42.0	10,000	0.015	0.151	**0.003**	0.015	0.115	47	4.06	0.47	0.62
1-11 TO 1-10	1500	500	7.48	49.5	14,960	0.023	0.174	**0.003**	0.022	0.137	49	3.95	0.54	0.71
1-10 TO 1-9	1500	500	4.85	54.3	9,700	0.015	0.189	**0.003**	0.015	0.152	50	3.83	0.58	0.77
1-9 TO 1-8	1500	500	1.02	55.4	2,040	0.003	0.192	**0.003**	0.003	0.155	50	3.83	0.59	0.78
1-8 TO 1-7	1500	500	1.84	57.2	3,680	0.006	0.198	**0.003**	0.006	0.161	51	3.83	0.62	0.82
1-7 TO 1-6	1500	500	1.34	58.6	2,680	0.004	0.202	**0.003**	0.004	0.165	51	3.78	0.62	0.82
1-4 TO 1-3	1500	500	2.34	60.9	4,680	0.007	0.209	**0.003**	0.007	0.172	52	3.78	0.65	0.86
1-3 TO 1-2	1500	500	5.27	66.2	10,540	0.016	0.225	**0.003**	0.016	0.188	53	3.72	0.70	0.93
1-2 TO 1-1	1500	500	21.08	87.3	42,160	0.065	0.290	**0.003**	0.063	0.251	57	3.49	0.88	1.17
J-5 TO J-4	1500	500	54.26	141.5	108,520	0.168	0.458	**0.003**	0.163	0.414	64	3.17	1.31	1.76
G-1 TO A-2	1500	500	37.92	179.5	75,840	0.117	0.575	**0.003**	0.114	0.528	68	3.09	1.63	2.21
A-2 TO A-1 (*)	1500	500	36.31	215.8	72,620	0.112	0.687	0.006	0.218	0.746	72	3.03	2.26	2.95
(*) Dominate type in this area is VCP, though some PVC														

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Appendix C

- West System Flow Analysis

West System

Line No.	Flow Rate	Line Size	Line Length	Invert Dn	Invert Up	Line Slope	HGL Dn	HGL Up	HGL Junct	Capac. Full	Line No.	Line ID	Hw (ft)	Grnd/Rim Elev Up	n-value Pipe
	(cfs)	(in)	(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(ft)	(cfs)				(ft)	
4	2.95	10	223.20	807.86	814.84	0.0313	808.44	815.59	815.59	3.60	4	A2-A1	0.75	820.87	0.014
5	2.21	8	199.38	815.00	820.05	0.0253	815.72	824.61	824.74	1.67	5	G1-A2	4.69	826.13	0.015
6	1.78	8	324.00	820.18	830.57	0.0321	825.12	834.49	834.57	1.87	6	J1 - G1	4.00	835.50	0.015
7	1.78	8	399.50	830.77	841.38	0.0266	834.74	846.29	846.37	1.71	7	J2-J1	4.99	846.68	0.015
8	1.78	8	307.50	841.58	850.96	0.0305	846.54	855.43	855.52	1.83	8	J3-J2	4.56	857.08	0.015
9	1.78	8	268.00	851.16	865.95	0.0552	855.68	866.56	866.56	2.46	9	J4-J3	0.61	870.35	0.015
10	1.78	8	322.00	866.15	877.83	0.0363	866.64	878.44	878.44	1.99	10	J5-J4	0.61	892.53	0.015
11	1.78	8	80.30	878.00	895.29	0.2153	878.28	895.90	895.90	5.20	11	J6-J5	0.61	900.49	0.014
12	1.17	8	143.45	895.66	907.28	0.081	895.94	907.79	907.79	3.19	12	1-1 - J6	0.51	916.21	0.014
13	1.17	8	137.80	907.80	911.08	0.0238	908.21	911.59	911.59	1.73	13	1-2 - 1-1	0.51	928.78	0.014
14	0.93	8	89.75	911.72	912.04	0.0036	912.39	913.00	913.03	0.67	14	1-3 - 1-2	0.99	928.60	0.014
15	0.86	8	152.23	912.25	913.49	0.0081	913.15	914.03	914.06	1.01	15	1-4 - 1-3	0.57	935.65	0.014
16	0.83	8	154.95	913.84	914.92	0.007	914.33	915.41	915.46	0.94	16	1-5 - 1-4	0.54	936.27	0.014