

Appendix 9: Drainage Calculations

Hydraulic Calculation (Discharge Capacity of Drainage Facilities)(1/3)

Basin No.	Design Rainfall Intensity γ (mm/h)	Catchment Area Road Surface/Slope (m ²)	Run-off Coefficient (C)	Discharge Q (m ³ /s)	Remarks
◇ 1	127.0	987	0.90	0.031	
◇ 2	127.0	660	0.90	0.021	
◇ 3	127.0	987	0.90	0.031	
◇ 4	127.0	6,869	0.90	0.218	
◇ 5	127.0	5,107	0.90	0.162	
◇ 6	127.0	6,734	0.90	0.214	
◇ 7	127.0	2,785	0.90	0.088	
◇ 8	127.0	5,658	0.90	0.180	
○ 1	127.0	2,524	0.90	0.080	
○ 2	127.0	5,855	0.90	0.186	
○ 3	127.0	2,122	0.90	0.067	
○ 4	127.0	3,188	0.90	0.101	
○ 6	127.0	3,873	0.90	0.123	
○ 7	127.0	1,227	0.90	0.039	
○ 8	127.0	7,041	0.90	0.224	
○ 9	127.0	6,019	0.90	0.191	
○ 10	127.0	3,468	0.90	0.110	
○ 11	127.0	519	0.90	0.016	
○ 12	127.0	5,052	0.90	0.160	
○ 13	127.0	522	0.90	0.017	
○ 14	127.0	4,444	0.90	0.141	
○ 15	127.0	2,069	0.90	0.066	
○ 16	127.0	6,210	0.90	0.197	

Hydraulic Calculation (Discharge Capacity of Drainage Facilities)(2/3)

Basin No.	Design Rainfall Intensity γ (mm/h)	Catchment Area Road Surface/Slope (m ²)	Run-off Coefficient (C)	Discharge Q (m ³ /s)	Remarks
○ 17	127.0	6,253	0.90	0.199	
○ 18	127.0	1,962	0.90	0.062	
○ 19	127.0	5,094	0.90	0.162	
○ 20	127.0	335	0.90	0.011	
○ 21	127.0	6,103	0.90	0.194	
○ 22	127.0	2,403	0.90	0.076	
○ 23	127.0	1,333	0.90	0.042	
○ 24	127.0	1,633	0.90	0.052	
○ 25	127.0	2,784	0.90	0.088	
○ 26	127.0	1,995	0.90	0.063	
○ 27	127.0	740	0.90	0.023	
○ 28	127.0	866	0.90	0.027	
○ 29	127.0	3,158	0.90	0.100	
○ 30	127.0	477	0.90	0.015	
○ 31	127.0	197	0.90	0.006	
○ 32	127.0	749	0.90	0.024	
○ 33	127.0	1,782	0.90	0.057	
□ 1	127.0	1,719	0.90	0.055	
□ 2	127.0	1,839	0.90	0.058	
□ 3	127.0	1,028	0.90	0.033	
□ 4-1	127.0	4,478	0.90	0.142	
□ 4-2	127.0	5,276	0.90	0.168	
□ 5	127.0	4,966	0.90	0.158	

Capacity of Drainage Facilities (1/4)

Outlet	Drain No.	Basin No.	Catchment Area (m ²)	Accumulated Discharge Q (m ³ /s)	Code	Flow Area of Drain Facility			Capacity of Drain Facility					
						Shape/Dimension	Parameters			Gradient (%)	Flow Sneed (m/s)	80% Discharge Q80	Capacity O/(O80*100 (m ³ /s)	Judgement
							n	R ^{2/3}	A					
Motorway	1	1	987	0.031	128	U-300×300	0.015	0.204	0.072	0.400	0.860	0.062	50.00	OK
	2	2	660	0.021	128	U-300×300	0.015	0.204	0.072	0.400	0.860	0.062	33.87	OK
	3	5	5,107	0.162	138	U-500×500	0.015	0.287	0.200	0.400	1.210	0.242	66.94	OK
	4	2 3	5,767	0.183	196	Bx-500×300	0.015	0.244	0.118	1.000	1.620	0.192	95.31	OK
	5	4	6,869	0.218	142	U-600×500	0.015	0.309	0.240	0.400	1.300	0.312	69.87	OK
	6	1 4 5	13,623	0.432	142	U-600×500	0.015	0.309	0.240	2.000	2.910	0.699	61.80	OK
	7	3	987	0.031	128	U-300×300	0.015	0.204	0.072	0.400	0.860	0.062	50.00	OK
	8	6	6,734	0.214	142	U-600×500	0.015	0.309	0.240	0.400	1.300	0.312	68.59	OK
	9	7	2,785	0.088	132	U-400×300	0.015	0.228	0.096	2.000	2.140	0.206	42.72	OK
	10	8	5,658	0.180	128	U-300×300	0.015	0.204	0.072	3.933	2.690	0.194	92.78	OK
	11	9 10	8,443	0.268	217	V-shaped Ditch-2000×1000	0.015	0.431	0.640	0.400	1.810	1.159	23.12	OK
Aflao	1	1	2,524	0.080	132	U-400×300	0.015	0.228	0.096	0.400	0.960	0.093	86.02	OK
	2	2	5,855	0.186	132	U-400×300	0.015	0.228	0.096	2.658	2.470	0.238	78.15	OK
	3	1 2	8,379	0.266	195	Bx-400×300	0.015	0.225	0.094	5.700	3.580	0.337	78.93	OK
	4	3 4	11,567	0.367	146	U-700×500	0.015	0.327	0.280	0.400	1.370	0.384	95.57	OK
	5	4 7	12,794	0.406	147	U-700×600	0.015	0.345	0.336	0.400	1.450	0.488	83.20	OK
	6	3	2,122	0.067	142	U-600×500	0.015	0.309	0.240	0.400	1.300	0.312	21.47	OK
	9	6	3,873	0.123	147	U-700×600	0.015	0.345	0.336	0.400	1.450	0.488	25.20	OK
	10	5 10	16,262	0.516	147	U-700×600	0.015	0.345	0.336	0.500	1.620	0.545	94.68	OK
	11	9 11	4,392	0.139	147	U-700×600	0.015	0.345	0.336	0.400	1.450	0.488	28.48	OK
	12	13	522	0.017	128	U-300×300	0.015	0.204	0.072	4.653	2.930	0.211	8.06	OK
	13	12	5,052	0.160	128	U-300×300	0.015	0.204	0.072	4.653	2.930	0.211	75.83	OK
	14	11 13	9,444	0.299	199	Bx-700×500	0.015	0.325	0.278	0.400	1.370	0.381	78.48	OK
	15	12 14	9,966	0.316	199	Bx-700×500	0.015	0.325	0.278	0.400	1.370	0.381	82.94	OK
	16	10	16,262	0.516	200	Bx-800×600	0.015	0.361	0.382	0.400	1.520	0.581	88.81	OK

Capacity of Drainage Facilities (2/4)

Outlet	Drain No.	Basin No.	Catchment Area (m ²)	Accumulated Discharge Q (m ³ /s)	Code	Flow Area of Drain Facility			Capacity of Drain Facility					
						Shape/Dimension	Parameters			Gradient (%)	Flow Sneed (m/s)	80% Discharge Q ₈₀	Capacity Q/(0.80*100) (m ³ /s)	Judgement
							n	R ^{2/3}	A					
Aflao	17	15 16 14	30,672	0.973	156	U-1000×900	0.015	0.443	0.720	0.400	1.860	1.340	72.61	OK
	18	8	7,041	0.224	132	U-400×300	0.015	0.228	0.096	3.531	2.850	0.274	81.75	OK
	19	5 9	8,141	0.258	142	U-600×500	0.015	0.309	0.240	0.400	1.300	0.312	82.69	OK
	20	19	8,141	0.258	196	Bx-500×300	0.015	0.244	0.118	2.500	2.570	0.304	84.87	OK
	21	18 20 15	17,251	0.548	151	U-800×600	0.015	0.362	0.384	0.400	1.520	0.584	93.84	OK
	22	16	6,210	0.197	138	U-500×500	0.015	0.287	0.200	0.400	1.210	0.242	81.40	OK
	23	17	6,253	0.199	138	U-500×500	0.015	0.287	0.200	0.400	1.210	0.242	82.23	OK
	24	18	1,962	0.062	133	U-400×400	0.015	0.247	0.128	0.564	1.230	0.158	39.24	OK
	25	24	1,962	0.062	196	Bx-500×300	0.015	0.244	0.118	0.400	1.020	0.121	51.24	OK
	26	19	5,094	0.162	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	0.564	1.360	0.218	74.31	OK
	27	26	5,094	0.162	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	0.400	1.140	0.183	88.52	OK
	28	27	5,094	0.162	196	Bx-500×300	0.015	0.244	0.118	1.000	1.620	0.192	84.38	OK
	29	20	335	0.011	128	U-300×300	0.015	0.204	0.072	0.400	0.860	0.062	17.74	OK
	30	28 29 23	6,762	0.215	139	U-500×600	0.015	0.300	0.240	0.400	1.260	0.303	70.96	OK
	31	30 24	8,395	0.267	143	U-600×600	0.015	0.324	0.288	0.400	1.360	0.392	68.11	OK
	32	21	6,103	0.194	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	0.500	1.280	0.205	94.63	OK
	33	33	1,782	0.057	194	Bx-300×300	0.015	0.200	0.070	1.000	1.330	0.094	60.64	OK
	34	32	749	0.024	128	U-300×300	0.015	0.204	0.072	0.437	0.890	0.065	36.92	OK
	35	33 34 31	2,728	0.087	130	U-300×500	0.015	0.228	0.120	0.400	0.960	0.116	75.00	OK
	36	35	2,728	0.087	194	Bx-300×300	0.015	0.200	0.070	2.500	2.100	0.147	59.18	OK
	37	25	2,784	0.088	130	U-300×500	0.015	0.228	0.120	0.400	0.960	0.116	75.86	OK
	38	22	2,403	0.076	130	U-300×500	0.015	0.228	0.120	0.400	0.960	0.116	65.52	OK
	39	36 37 38	7,915	0.251	130	U-300×500	0.015	0.228	0.120	5.000	3.390	0.407	61.67	OK
	40	26	1,995	0.063	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	0.400	1.140	0.183	34.43	OK
41	32 39 40	16,013	0.508	199	Bx-700×500	0.015	0.325	0.278	0.750	1.870	0.520	97.69	OK	

Capacity of Drainage Facilities (3/4)

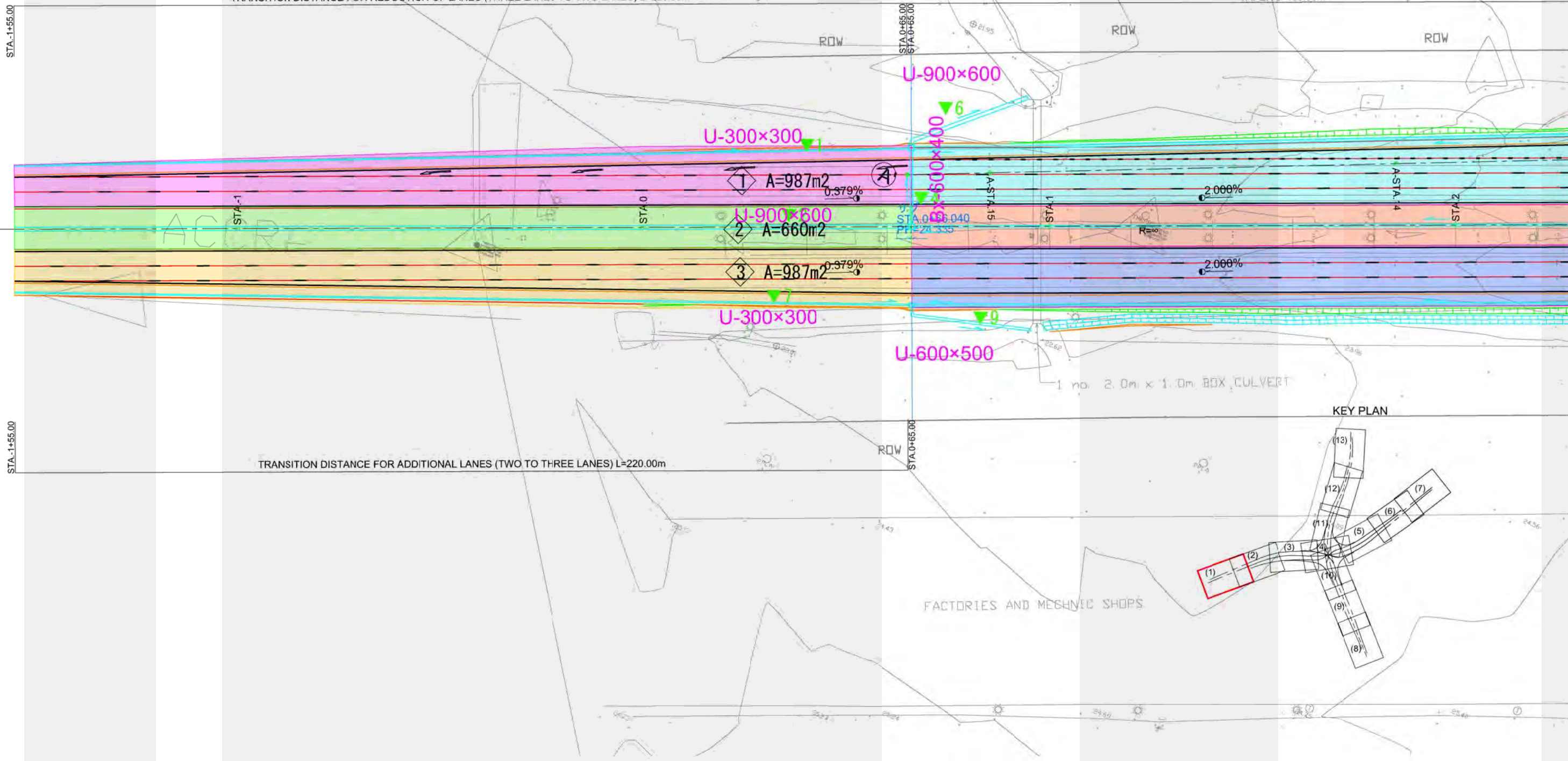
Outlet	Drain No.	Basin No.	Catchment Area (m ²)	Accumulated Discharge Q (m ³ /s)	Code	Flow Area of Drain Facility			Capacity of Drain Facility					
						Shape/Dimension	Parameters			Gradient (%)	Flow Sneed (m/s)	80% Discharge Q80	Capacity Q/(0.80*100) (m ³ /s)	Judgement
							n	R ^{2/3}	A					
Aflao	42	28	866	0.027	128	U-300×300	0.015	0.204	0.072	0.937	1.310	0.095	28.42	OK
	43	42	866	0.027	194	Bx-300×300	0.015	0.200	0.070	0.400	0.840	0.059	45.76	OK
	44	43 27	1,606	0.050	134	U-400×500	0.015	0.261	0.160	0.400	1.100	0.176	28.41	OK
	45	44 29	4,764	0.150	134	U-400×500	0.015	0.261	0.160	2.000	2.460	0.394	38.07	OK
	46	45	4,764	0.150	196	Bx-500×300	0.015	0.244	0.118	2.000	2.300	0.272	55.15	OK
	47	30	477	0.015	128	U-300×300	0.015	0.204	0.072	0.400	0.860	0.062	24.19	OK
	48	31 41 46 47	29,649	0.940	147	U-700×600	0.015	0.345	0.336	2.000	3.250	1.092	86.08	OK
	harbour	1	1	1,719	0.055	128	U-300×300	0.015	0.204	0.072	1.000	1.360	0.098	56.12
2		1	1,719	0.055	195	Bx-400×300	0.015	0.225	0.094	0.400	0.940	0.089	61.80	OK
3		2	1,719	0.055	130	U-300×500	0.015	0.228	0.120	0.400	0.960	0.116	47.41	OK
4		3 2	3,558	0.113	130	U-300×500	0.015	0.228	0.120	1.000	1.520	0.183	61.75	OK
5		4	3,558	0.113	194	Bx-300×300	0.015	0.200	0.070	2.600	2.140	0.150	75.33	OK
6		3	1,028	0.033	128	U-300×300	0.015	0.204	0.072	0.547	1.000	0.072	45.83	OK
7		5 6 5	9,552	0.304	139	U-500×600	0.015	0.300	0.240	0.492	1.400	0.336	90.48	OK
8		6	3,732	0.118	128	U-300×300	0.015	0.204	0.072	3.900	2.680	0.193	61.14	OK
9-1		4-1	4,478	0.142	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	1.090	1.890	0.303	46.86	OK
9-2		9-1	4,478	0.142	197	Bx-600×400	0.015	0.286	0.190	0.400	1.200	0.228	62.28	OK
10-1		4-2	5,276	0.168	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	0.567	1.360	0.218	77.06	OK
10-2		10-1	5,276	0.168	218	V-shaped Ditch-1000×500	0.015	0.272	0.160	0.400	1.140	0.183	91.80	OK
11		10	5,276	0.168	195	Bx-400×300	0.015	0.225	0.094	2.500	2.370	0.223	75.34	OK
12		8	3,732	0.038	128	U-300×300	0.015	0.204	0.072	1.035	1.380	0.100	38.00	OK
13		12	3,732	0.038	195	Bx-400×300	0.015	0.225	0.094	0.400	0.940	0.089	42.70	OK
14	13	3,732	0.038	130	U-300×500	0.015	0.228	0.120	1.000	1.520	0.183	20.77	OK	
15	14 9	5,566	0.096	130	U-300×500	0.015	0.228	0.120	1.000	1.520	0.183	52.46	OK	

STA -1+55.00

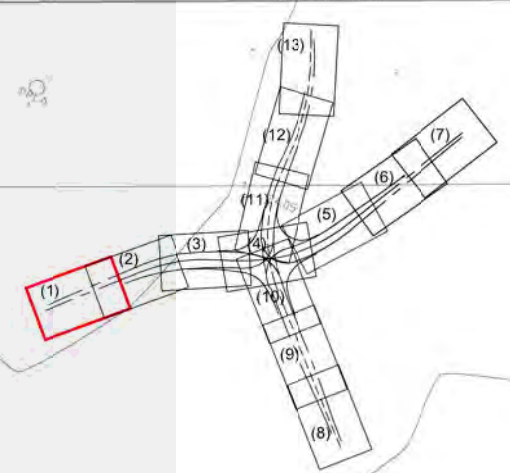
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TRANSITION DISTANCE FOR REDUCTION OF LANES (THREE LANES TO TWO LANES) L=220.00m

TAPER L=185.00m



KEY PLAN



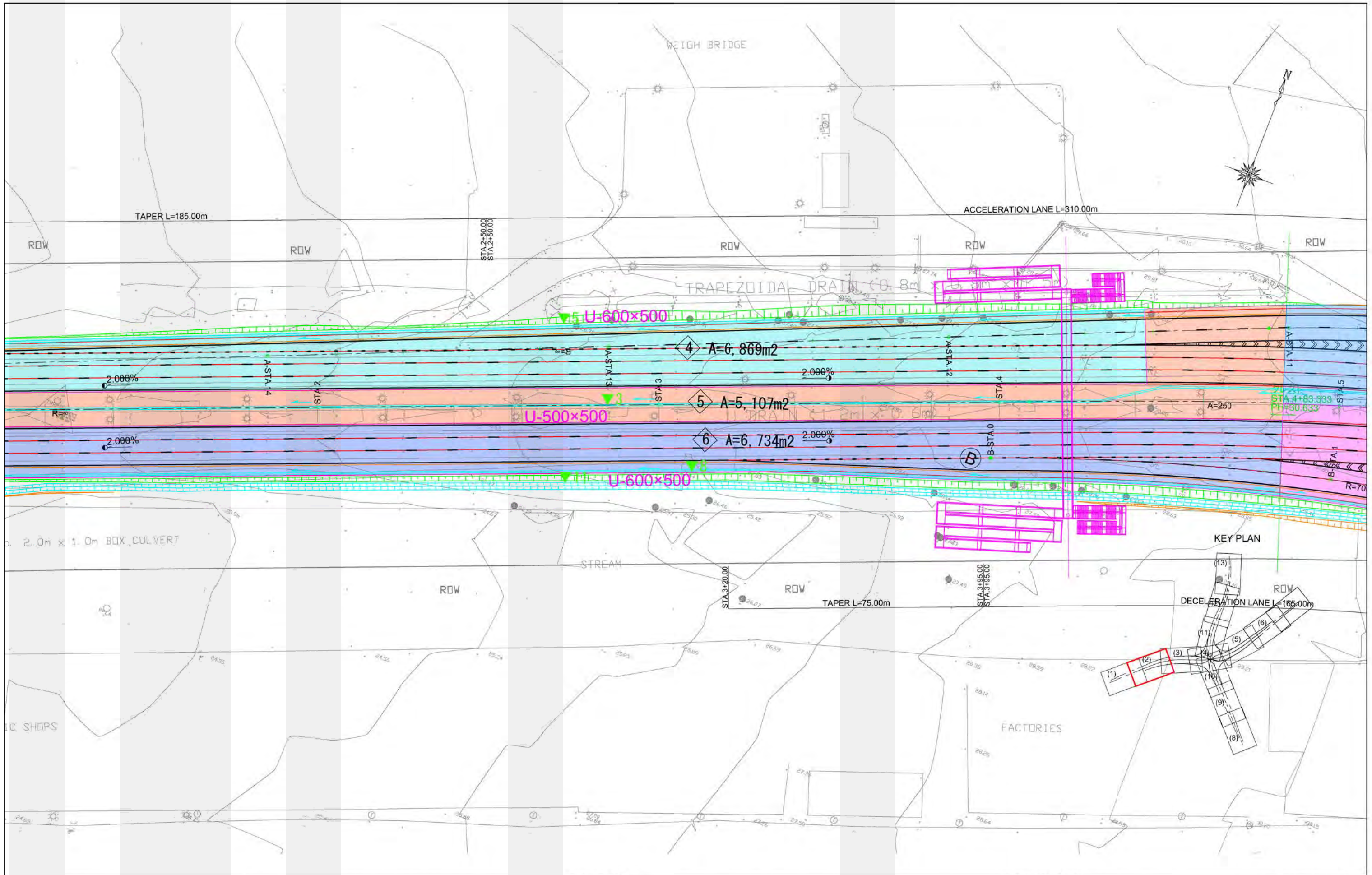
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PROJECT TITLE:
 PREPARATORY SURVEY ON THE PROJECT FOR THE IMPROVEMENT
 OF THE TEMA MOTORWAY ROUNDABOUT IN THE REPUBLIC OF GHANA

DRAWING TITLE:
BASIN PLAN(1)

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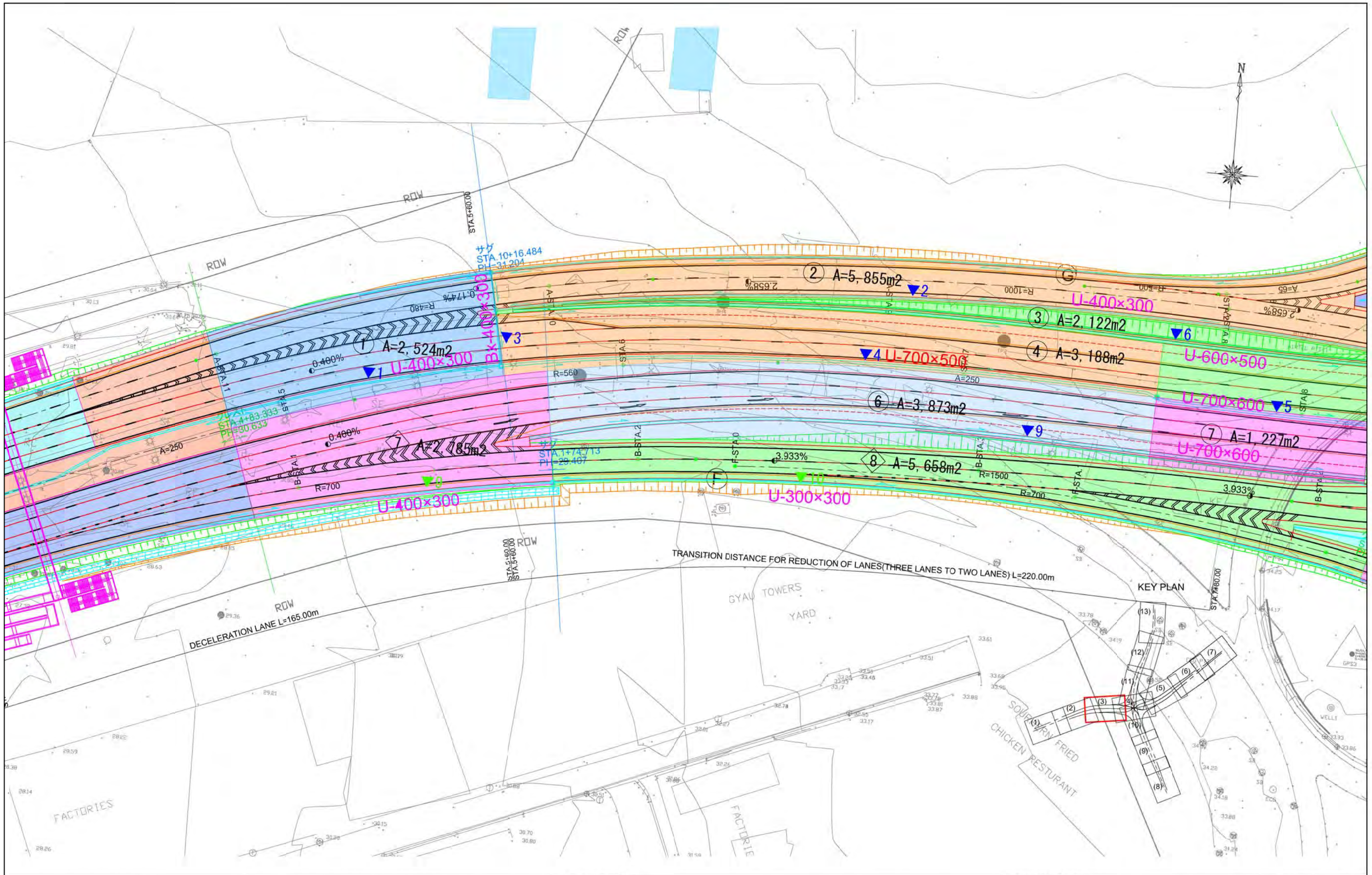
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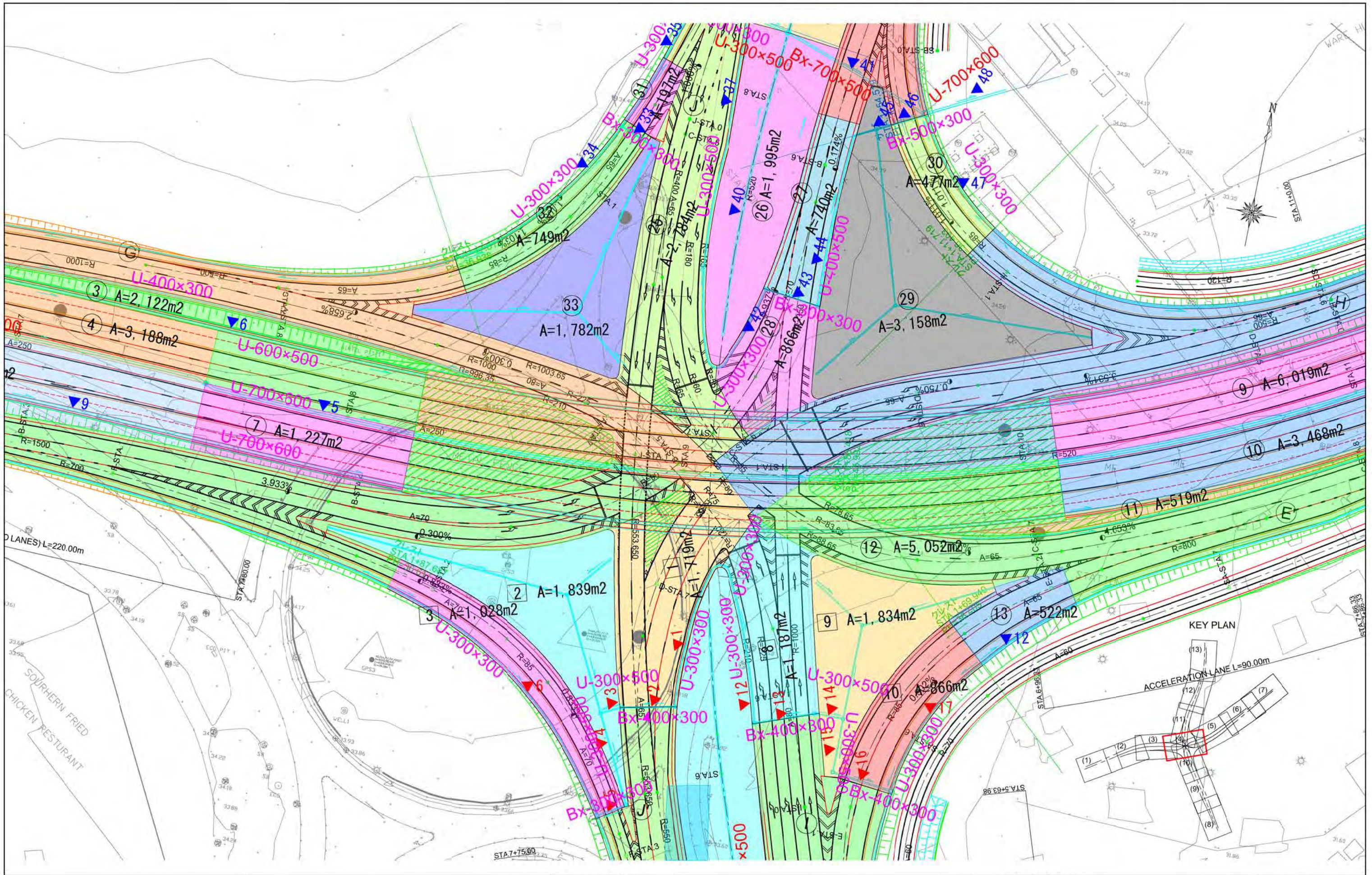
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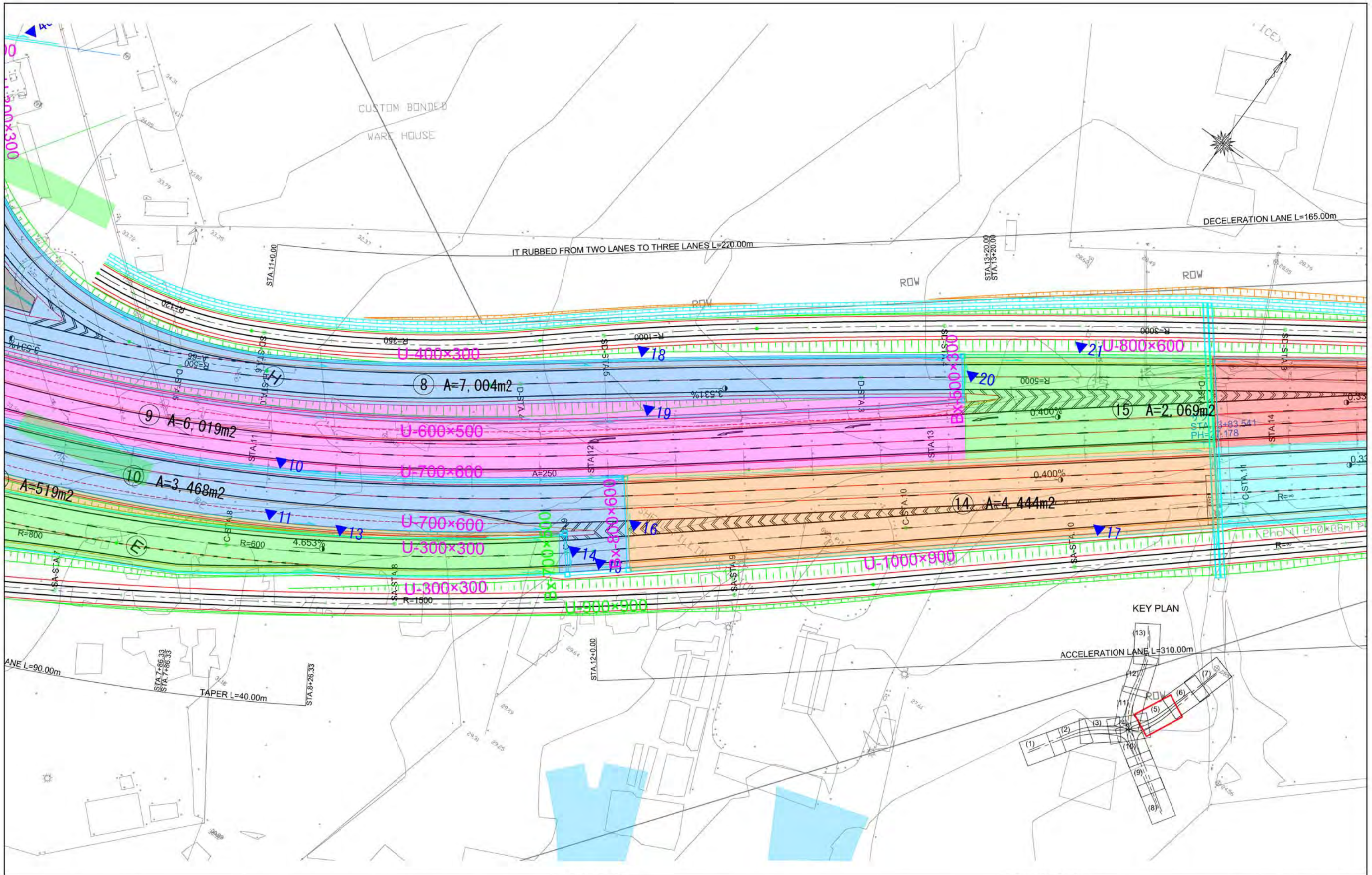
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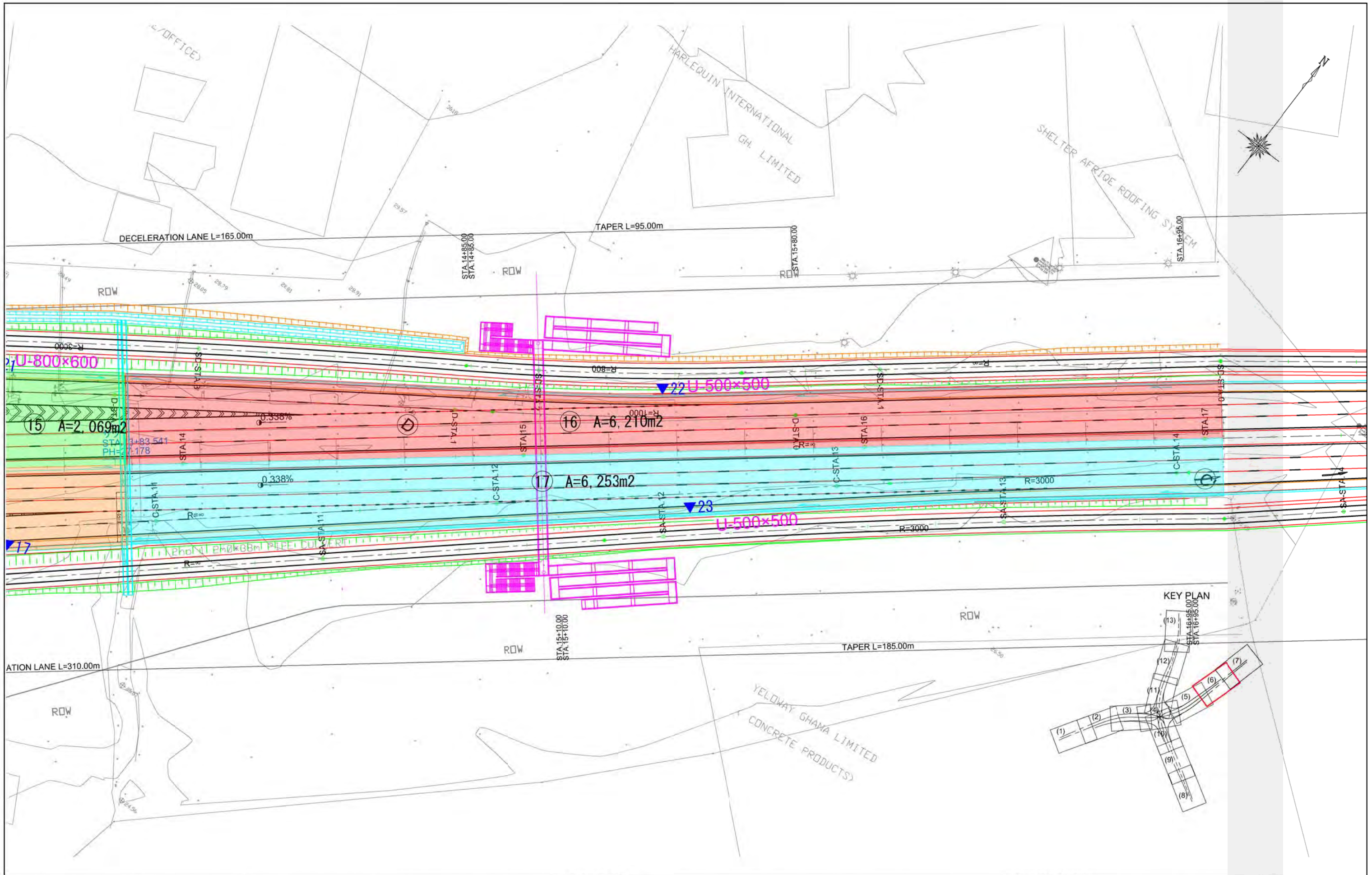
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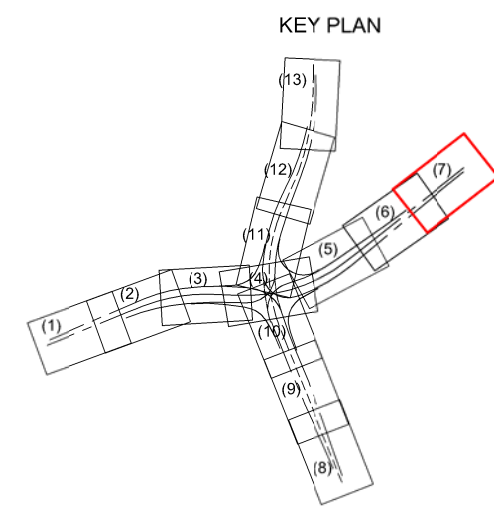
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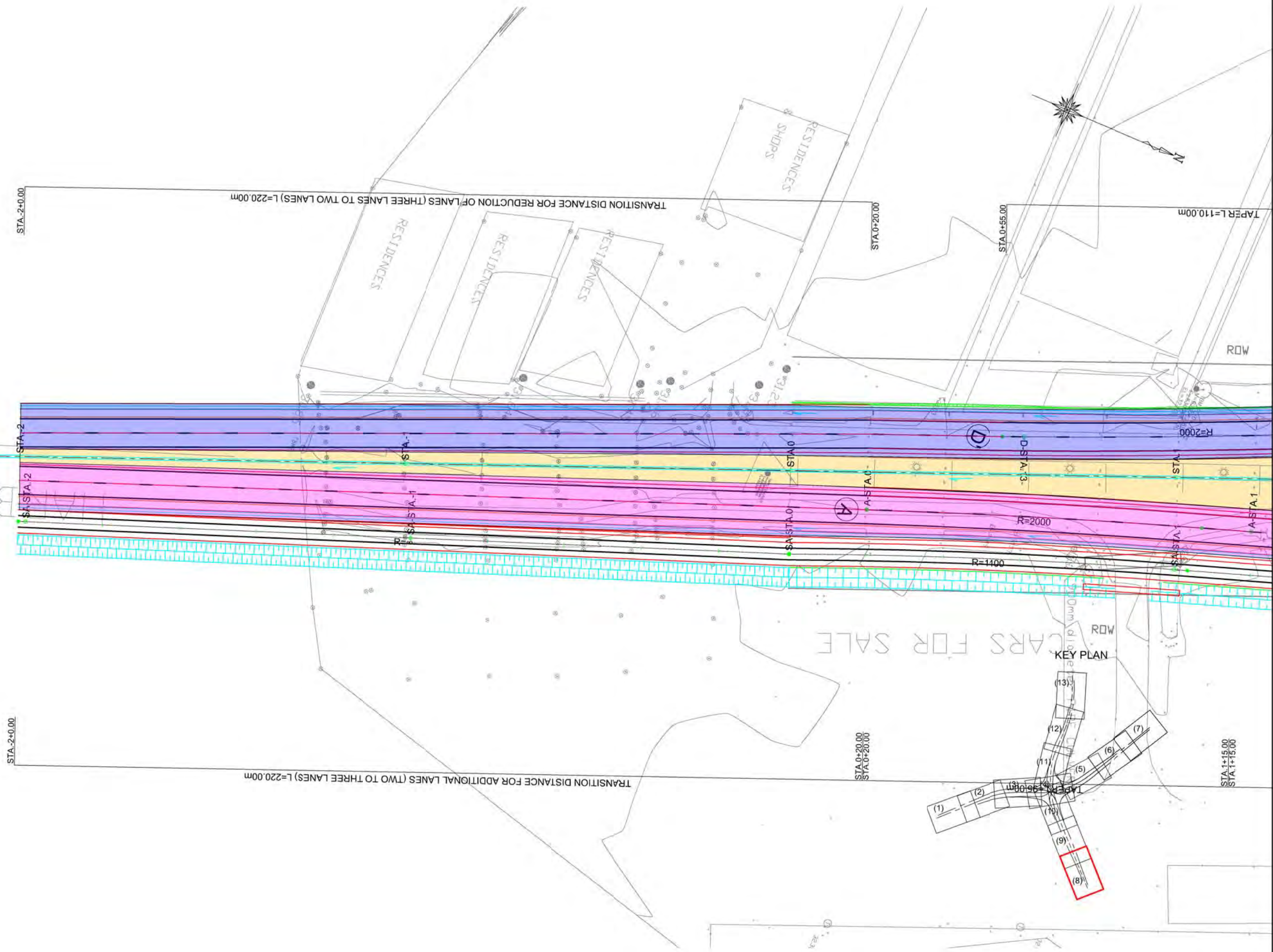
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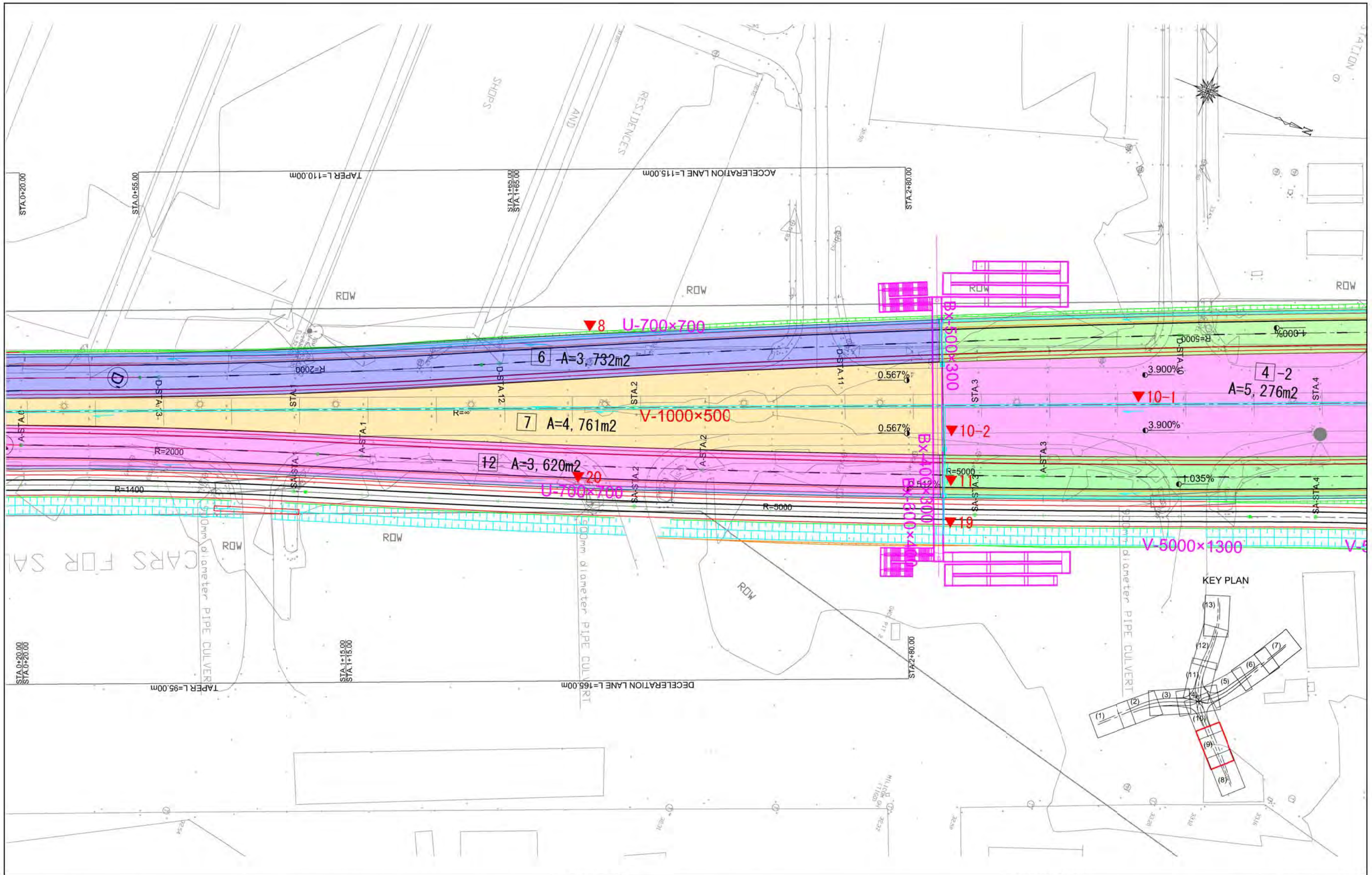
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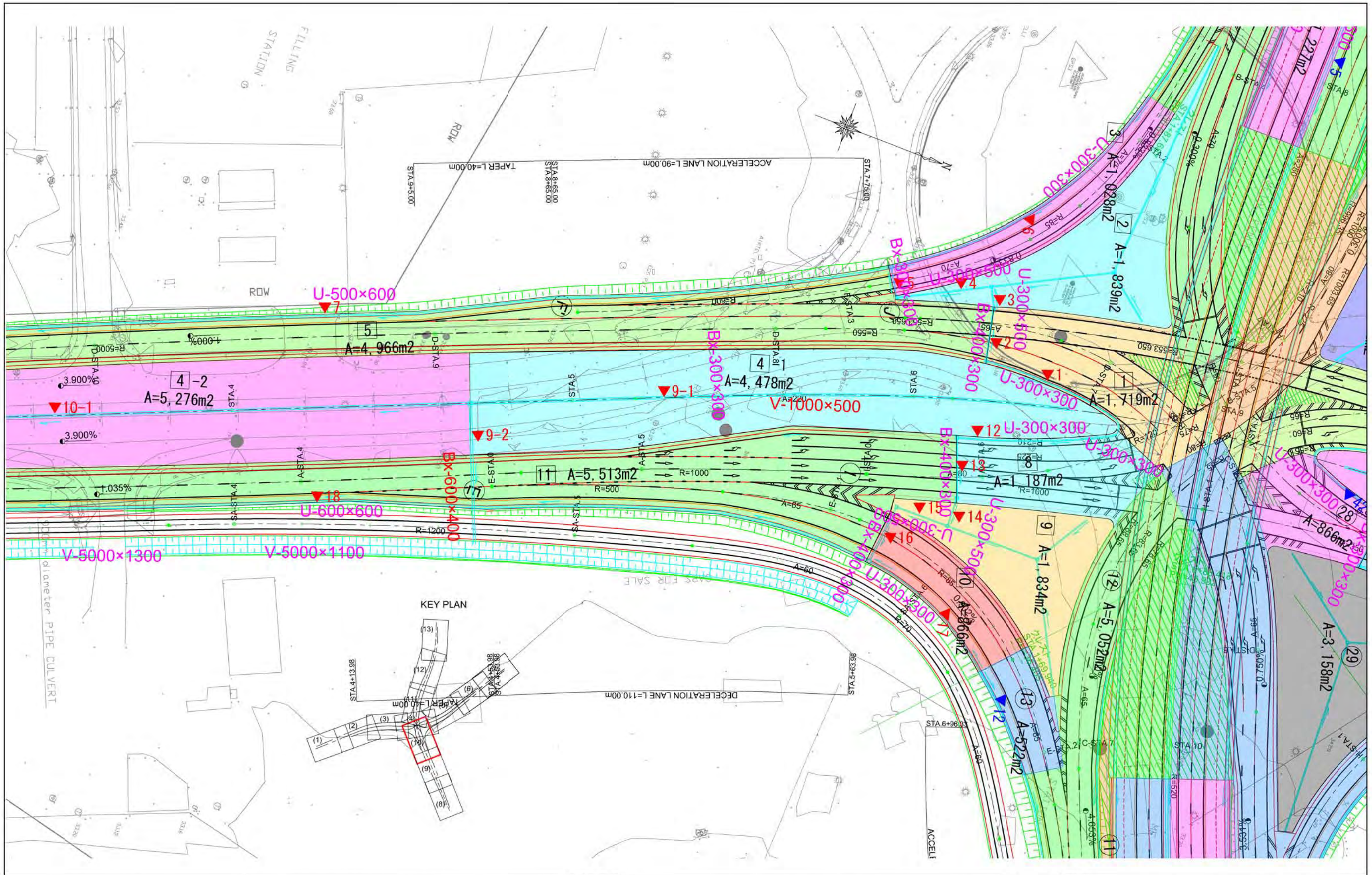
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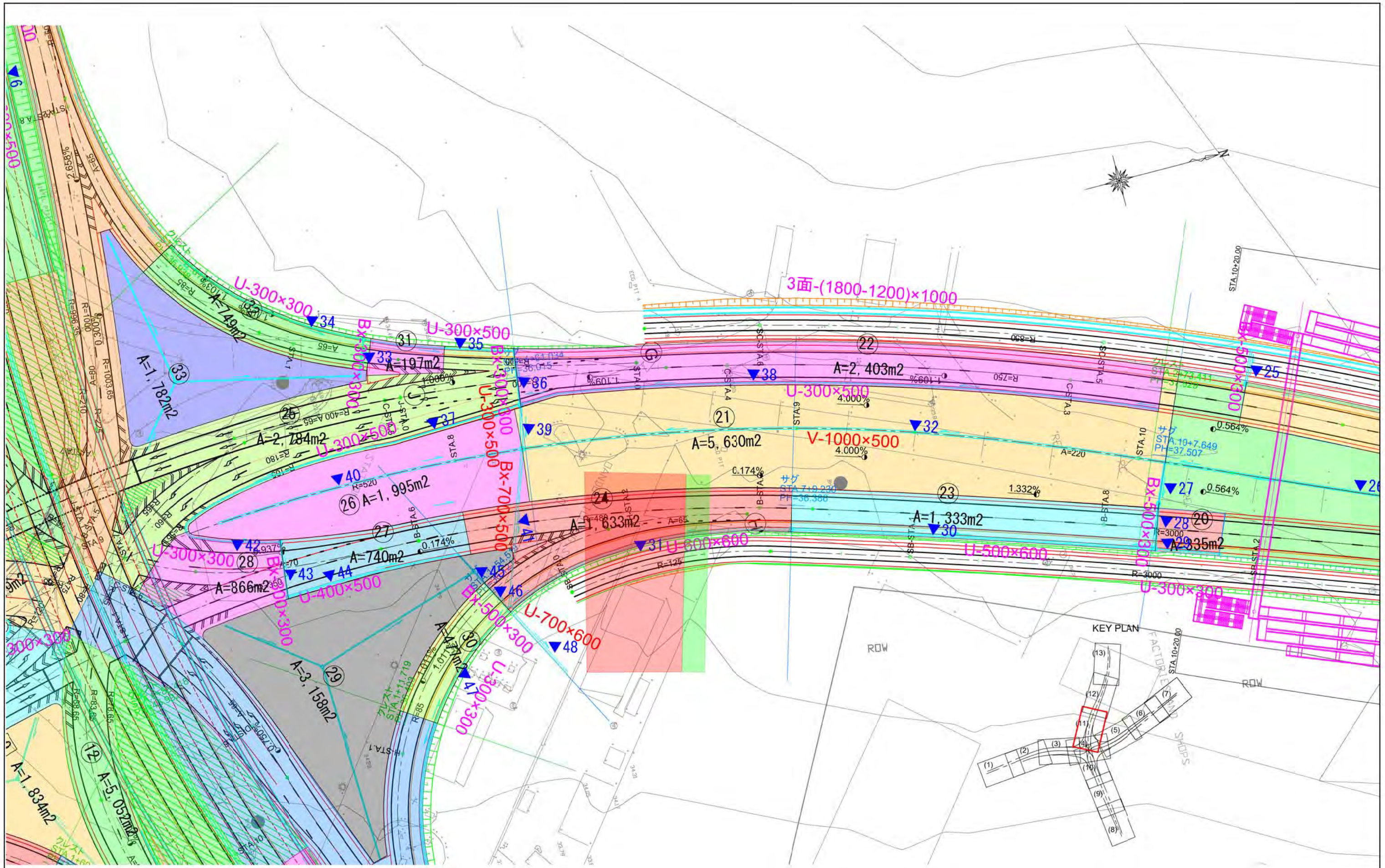
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BASIN PLAN (10)

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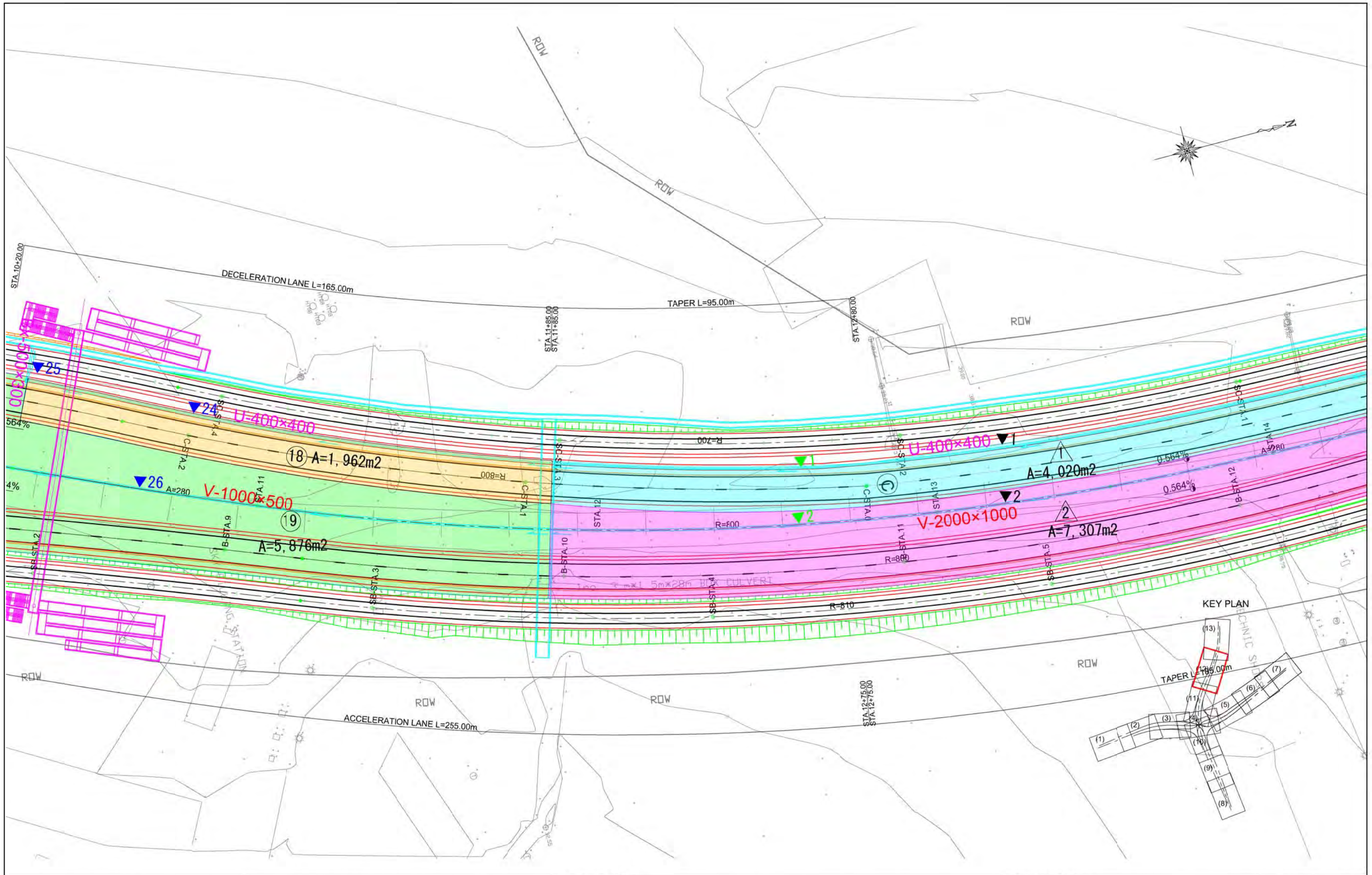
GHANA HIGHWAY AUTHORITY
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 REPUBLIC OF GHANA

CTI ENGINEERING INTERNATIONAL CO., LTD.
 JAPAN INTERNATIONAL COOPERATION AGENCY

PROJECT TITLE:
 PREPARATORY SURVEY ON THE PROJECT FOR THE IMPROVEMENT
 OF THE TEMA MOTORWAY ROUNDABOUT IN THE REPUBLIC OF GHANA

DRAWING TITLE:
BASIN PLAN(11)

SCALE	DRAWING NO.
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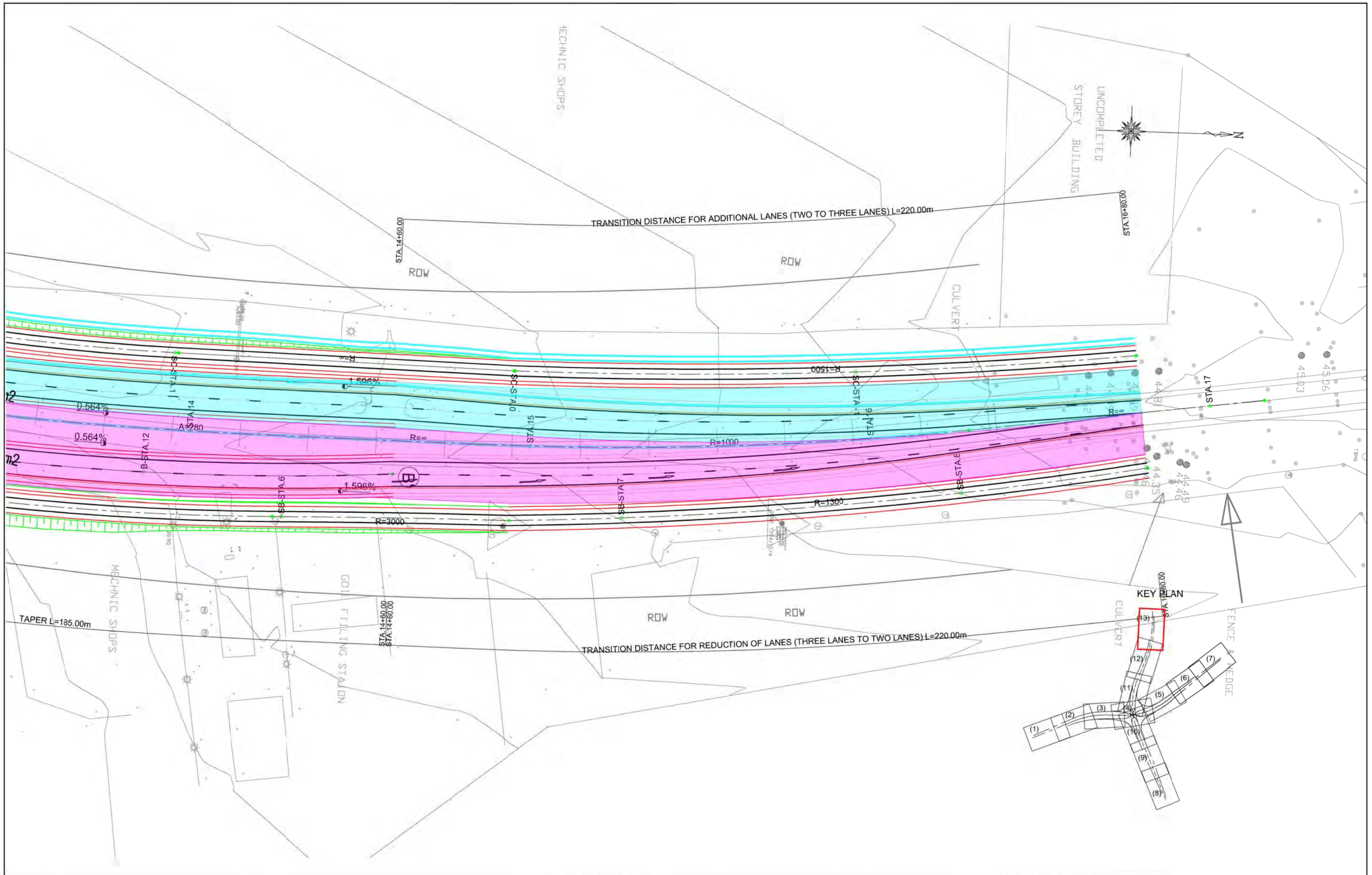
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PROJECT TITLE:
 PREPARATORY SURVEY ON THE PROJECT FOR THE IMPROVEMENT
 OF THE TEMA MOTORWAY ROUNDABOUT IN THE REPUBLIC OF GHANA

DRAWING TITLE:
BASIN PLAN (12)

SCALE	DRAWING NO.
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PROJECT TITLE:
 PREPARATORY SURVEY ON THE PROJECT FOR THE IMPROVEMENT
 OF THE TEMA MOTORWAY ROUNDABOUT IN THE REPUBLIC OF GHANA

DRAWING TITLE:
BASIN PLAN (13)

SCALE	DRAWING NO.
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