

Appendix 3.6 - Detailed Calculations of Albedo, Bowen Ratio and Surface Roughness

Land Cover	Area (km ²)	Fraction of Total Area	Albedo (r)	Bowen Ratio (Bo)
High Intensity Residential	12.12	0.12	0.180	1.500
Low Intensity Residential	29.02	0.29	0.165	0.900
Commercial/Industrial/Transport (Not at Airport)	2.88	0.03	0.180	1.500
Quarries/Strip Mines/Gravel	0.09	0.00	0.200	1.500
Deciduous Forest	24.78	0.25	0.163	0.750
Grasslands/Herbaceous	30.33	0.30	0.185	0.800
Open Water	0.80	0.01	0.100	0.100
Average:			0.172	0.881

Notes:

(a) Albedo was calculated based on the area-weighted arithmetic mean within 10km x 10km area from the Project Site. With reference to Table A-1 of the AERSURFACE User's Guide 2008 (revised in 2013), the albedos for High Intensity Residential (Class 22), Low Intensity Residential (Class 21), Commercial/Industrial/Transport (Not at Airport) (Class 23), Quarries/Strip Mines/Gravel (Class 32), Deciduous Forest (Class 41), Grasslands/Herbaceous (Class 71) and Open Water (Class 11) are assumed to be 0.18, 0.165, 0.18, 0.2, 0.163, 0.185 and 0.1, respectively.

(b) Bowen ratio was calculated based on the area-weighted geometric mean within 10km x 10km area from the Project Site. Considering the climate in Hong Kong covers dry and wet season throughout the year, bowen ratios for average moisture conditions have been adopted. With reference to Table A-2 of the AERSURFACE User's Guide 2008 (revised in 2013), the bowen ratios for High Intensity Residential (Class 22), Low Intensity Residential (Class 21), Commercial/Industrial/Transport (Not at Airport) (Class 23), Quarries/Strip Mines/Gravel (Class 32), Deciduous Forest (Class 41), Grasslands/Herbaceous (Class 71) and Open Water (Class 11) are assumed to be 1.5, 0.9, 1.5, 1.5, 0.75, 0.8 and 0.1, respectively.

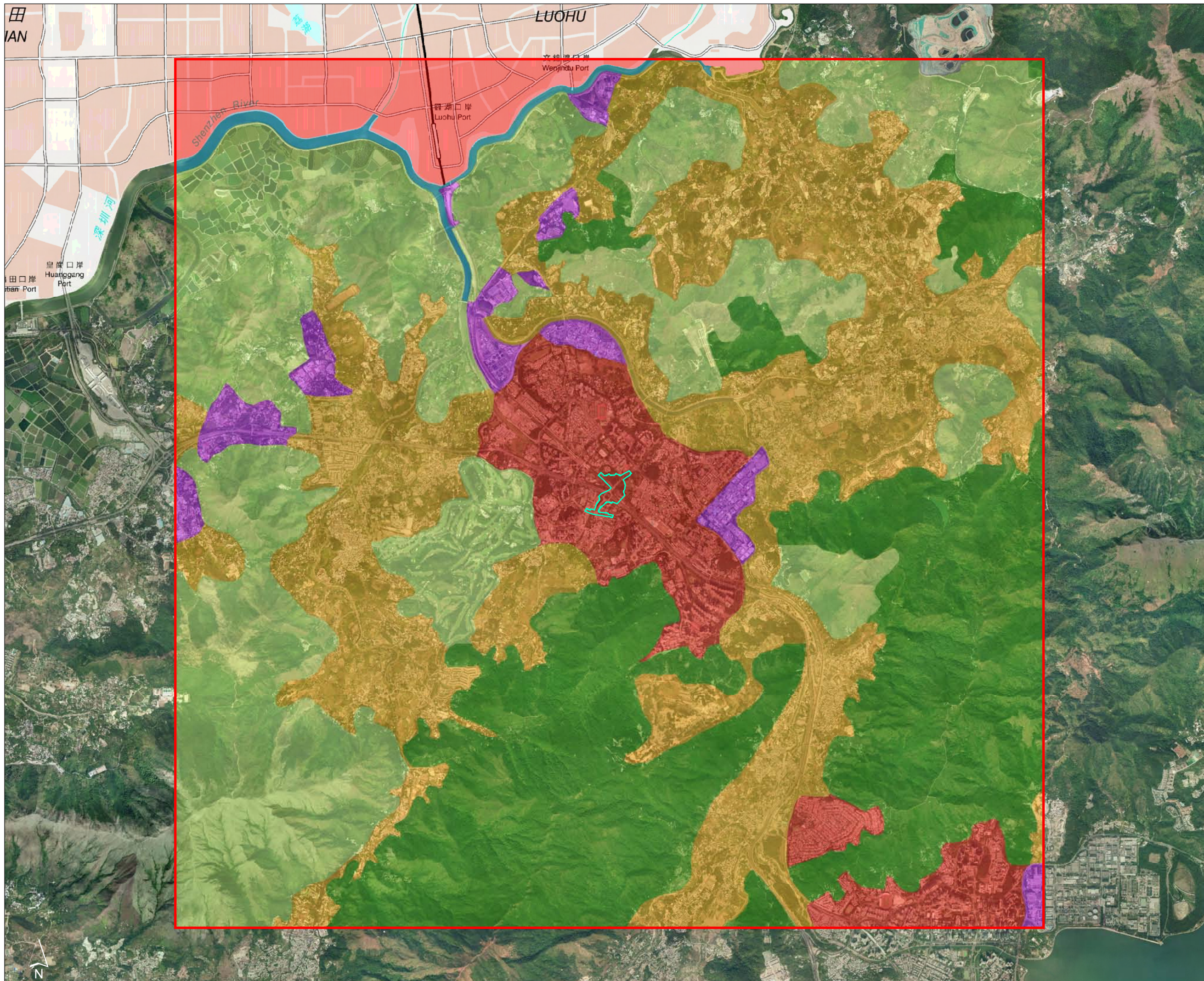
(c) The average of the albedo and bowen ratio values in spring, summer and autumn for each land use was used.

Appendix 3.6 - Detailed Calculations of Albedo, Bowen Ratio and Surface Roughness

PATH Grid	Sector (degree)	Land Use Type	Area (km ²)	Fraction of Section Total Area	Distance (km)	Weighting	Surface Roughness (Zo) ^(a)	Resultant Surface Roughness (Zo) (m) ^(a)	Albedo (r)	Bowen Ratio (Bo)
35, 52	65 - 110	High Intensity Residential	0.109	0.28	0.39	0.70	1.000	0.967	0.172	0.881
		Commercial/Industrial/Transport (Not at Airport)	0.038	0.10	0.62	0.16	0.700			
		High Intensity Residential	0.246	0.63	0.77	0.81	1.000			
	110 - 140	High Intensity Residential	0.045	0.17	0.27	0.63	1.000	0.888	0.172	0.881
		Deciduous Forest	0.057	0.22	0.53	0.41	0.600			
		High Intensity Residential	0.159	0.61	0.82	0.74	1.000			
	140 - 170	High Intensity Residential	0.045	0.17	0.27	0.63	1.000	0.739	0.172	0.881
		Deciduous Forest	0.078	0.30	0.56	0.53	0.600			
		Commercial/Industrial/Transport (Not at Airport)	0.069	0.26	0.76	0.35	0.700			
		Deciduous Forest	0.070	0.27	0.92	0.29	0.600			
	170 - 205	High Intensity Residential	0.051	0.17	0.27	0.62	1.000	0.293	0.172	0.881
		Deciduous Forest	0.073	0.24	0.53	0.45	0.600			
		Grasslands/Herbaceous	0.181	0.59	0.82	0.72	0.065			
	205 - 240	High Intensity Residential	0.080	0.26	0.35	0.76	1.000	0.353	0.172	0.881
Grasslands/Herbaceous		0.092	0.30	0.62	0.48	0.065				
Low Intensity Residential		0.134	0.44	0.87	0.50	0.375				
240 - 310	High Intensity Residential	0.223	0.37	0.38	0.96	1.000	0.283	0.172	0.881	
	Grasslands/Herbaceous	0.388	0.63	0.77	0.83	0.065				
310 - 65	High Intensity Residential	0.120	0.12	0.23	0.52	1.000	0.972	0.172	0.881	
	Commercial/Industrial/Transport (Not at Airport)	0.065	0.07	0.41	0.16	0.700				
	High Intensity Residential	0.818	0.82	0.63	1.29	1.000				
35, 53	75 - 115	Deciduous Forest	0.160	0.46	0.45	1.03	0.600	0.731	0.172	0.881
		High Intensity Residential	0.189	0.54	0.83	0.65	1.000			
	115 - 150	High Intensity Residential	0.305		0.66		1.000	1.000	0.172	0.881
	150 - 190	High Intensity Residential	0.109	0.31	0.38	0.82	1.000	0.601	0.172	0.881
		Low Intensity Residential	0.240	0.69	0.78	0.88	0.375			
	190 - 245	High Intensity Residential	0.258	0.54	0.48	1.13	1.000	0.407	0.172	0.881
		Grasslands/Herbaceous	0.221	0.46	0.83	0.55	0.065			
	245 - 280	Deciduous Forest	0.122	0.40	0.42	0.96	0.600	0.230	0.172	0.881
		Grasslands/Herbaceous	0.183	0.60	0.82	0.73	0.065			
	280 - 320	High Intensity Residential	0.114	0.33	0.38	0.85	1.000	0.611	0.172	0.881
		Low Intensity Residential	0.235	0.67	0.78	0.86	0.375			
	320 - 75	High Intensity Residential	0.062	0.06	0.19	0.33	1.000	0.964	0.172	0.881
		Commercial/Industrial/Transport (Not at Airport)	0.097	0.10	0.50	0.19	0.700			
		High Intensity Residential	0.845	0.84	0.62	1.37	1.000			
36, 52	30 - 125	High Intensity Residential	0.086	0.10	0.32	0.32	1.000	0.962	0.172	0.881
		Commercial/Industrial/Transport (Not at Airport)	0.085	0.10	0.55	0.19	0.700			
		High Intensity Residential	0.659	0.79	0.66	1.21	1.000			
	125 - 155	High Intensity Residential	0.131	0.50	0.47	1.07	1.000	0.835	0.172	0.881
		Deciduous Forest	0.130	0.50	0.85	0.58	0.600			
	155 - 190	High Intensity Residential	0.024	0.08	0.19	0.42	1.000	0.704	0.172	0.881
		Deciduous Forest	0.047	0.15	0.38	0.40	0.600			
		Commercial/Industrial/Transport (Not at Airport)	0.100	0.33	0.62	0.53	0.700			
		Deciduous Forest	0.134	0.44	0.87	0.51	0.600			
	190 - 225	High Intensity Residential	0.043	0.14	0.25	0.57	1.000	0.158	0.172	0.881
		Grasslands/Herbaceous	0.262	0.86	0.72	1.19	0.065			
	225 - 255	High Intensity Residential	0.182	0.69	0.55	1.27	1.000	0.814	0.172	0.881
		Low Intensity Residential	0.080	0.31	0.91	0.34	0.375			
	255 - 300	High Intensity Residential	0.276	0.70	0.55	1.29	1.000	0.572	0.172	0.881
Grasslands/Herbaceous		0.117	0.30	0.90	0.33	0.065				
300 - 30	High Intensity Residential	0.084	0.11	0.32	0.34	1.000	0.959	0.172	0.881	
	Commercial/Industrial/Transport (Not at Airport)	0.081	0.10	0.51	0.20	0.700				
	High Intensity Residential	0.620	0.79	0.67	1.18	1.000				
36, 53	20 - 50	High Intensity Residential	0.142	0.54	0.49	1.12	1.000	0.416	0.172	0.881
		Grasslands/Herbaceous	0.120	0.46	0.87	0.53	0.065			
	50 - 85	Deciduous Forest	0.086	0.28	0.35	0.81	0.600	0.788	0.172	0.881
		High Intensity Residential	0.219	0.72	0.78	0.92	1.000			
	85 - 135	Grasslands/Herbaceous	0.040	0.09	0.20	0.47	0.065	0.490	0.172	0.881
		High Intensity Residential	0.397	0.91	0.69	1.32	1.000			
	135 - 170	Commercial/Industrial/Transport (Not at Airport)	0.091	0.30	0.51	0.59	0.700	0.874	0.172	0.881
		High Intensity Residential	0.215	0.70	0.73	0.97	1.000			
	170 - 210	Commercial/Industrial/Transport (Not at Airport)	0.018	0.05	0.15	0.34	0.700	0.789	0.172	0.881
		High Intensity Residential	0.156	0.45	0.51	0.87	1.000			
		Deciduous Forest	0.176	0.50	0.83	0.61	0.600			
	210 - 310	Commercial/Industrial/Transport (Not at Airport)	0.113	0.13	0.42	0.31	0.700	0.937	0.172	0.881
		High Intensity Residential	0.760	0.87	0.63	1.39	1.000			
	310 - 20	High Intensity Residential	0.611		0.63		1.000	1.000	0.172	0.881

Note:

(a) With reference to Table A-3 of the AERSURFACE User's Guide 2008 (revised in 2013), the surface roughness values for Commercial/Industrial/Transport (Not at Airport) (Class 23), Grasslands/Herbaceous (Class 71), High Intensity Residential (Class 22), Low Intensity Residential (Class 21), Open Water (Class 11), Quarries/Strip Mines/Gravel (Class 32) are assumed to be 0.7m, 0.065m, 1m, 0.375m, 0.001m and 0.3m, respectively. With the height of tree assumed to be 6m on average, the surface roughness value of 0.6m has been adopted for trees (Deciduous Forest) based on the fact that the surface roughness value can be estimated as about 10% of the average height of physical structures. For sector consisting of 2 or more different land use types, the resultant surface roughness length for the sector is calculated based on the inverse-distance weighted geometric mean.



Legend

- Project Site Boundary for Construction Phase
- 10km X 10km Square from the Center of Project Site Boundary

Landuse

- High Intensity Residential
- Low Intensity Residential
- Grasslands/Herbaceous
- Deciduous Forest
- Open Water
- Commercial/Industrial/Transport (Not at Airport)
- Quarries/ Strip Mines/ Gravel

Rev	Description	By	Date
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Consultant



Project Title
IMPROVEMENT TO SO KWUN PO INTERCHANGE

Title
10km x 10km Area from Project Site

Drawing No. Appendix 3.6 Rev.

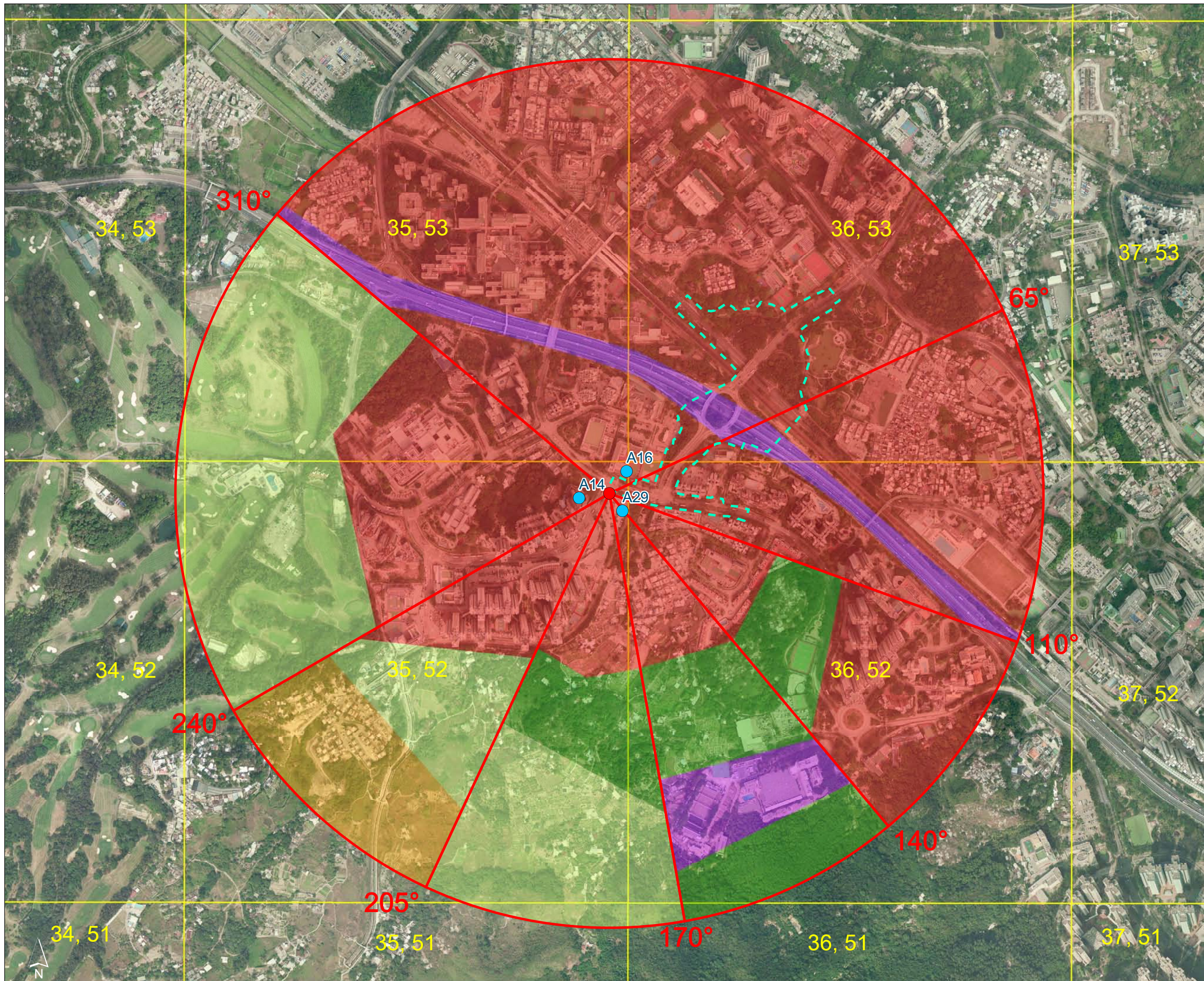
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- Legend**
- Center of ASRs
 - ASR
 - - - Project Site Boundary for Construction Phase
 - 1km Boundary from Center of ASRs
- Landuse**
- High Intensity Residential
 - Low Intensity Residential
 - Grasslands/Herbaceous
 - Deciduous Forest
 - Commercial/Industrial/Transport (Not at Airport)

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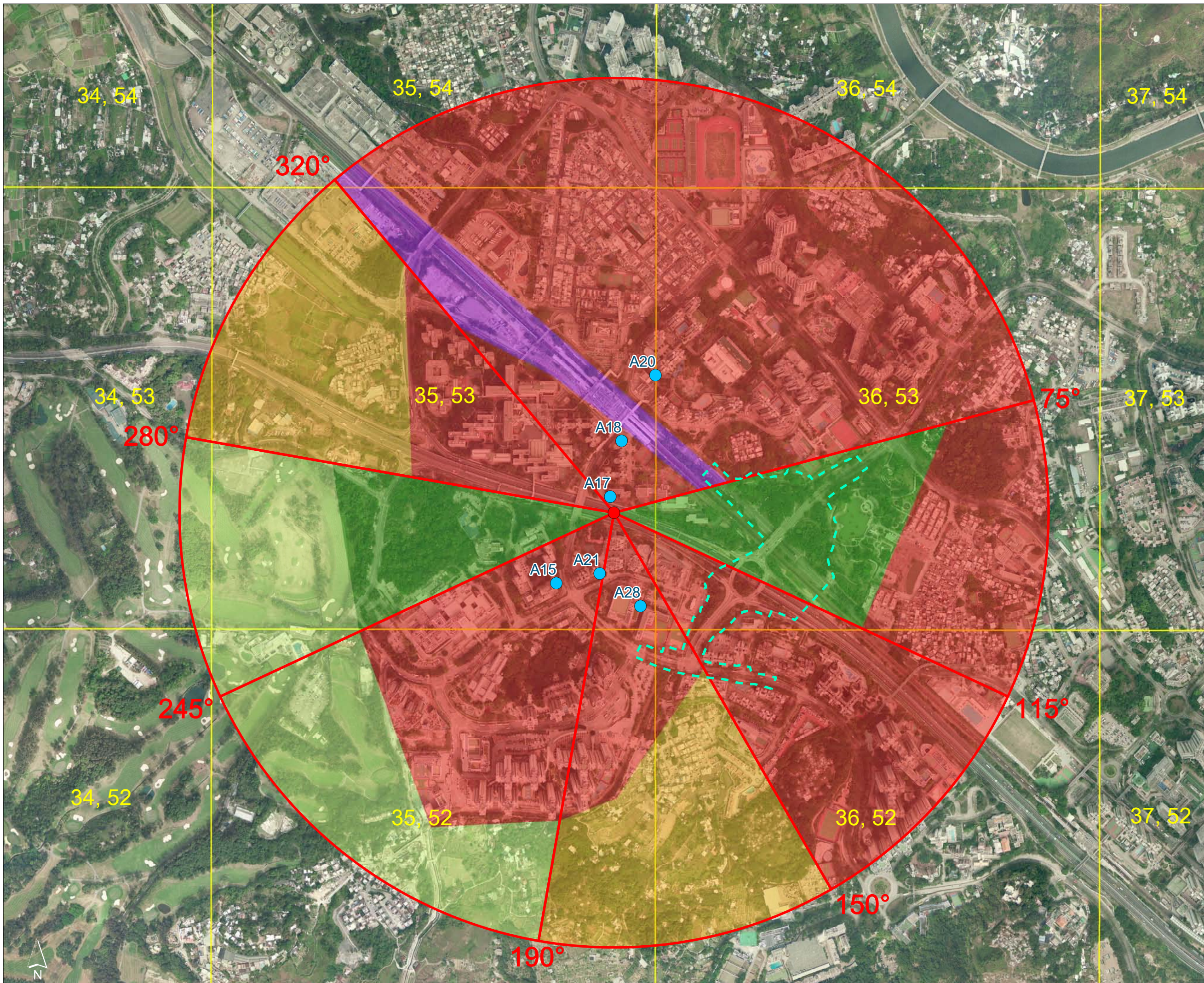
Project Title
IMPROVEMENT TO SO KWUN PO INTERCHANGE

Title
Sectors of Land Use for PATH Grid 35, 52

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- Legend**
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Project Title
IMPROVEMENT TO SO KWUN PO INTERCHANGE

Title
Sectors of Land Use for PATH Grid 35, 53

Drawing No. Appendix 3.6 Rev.

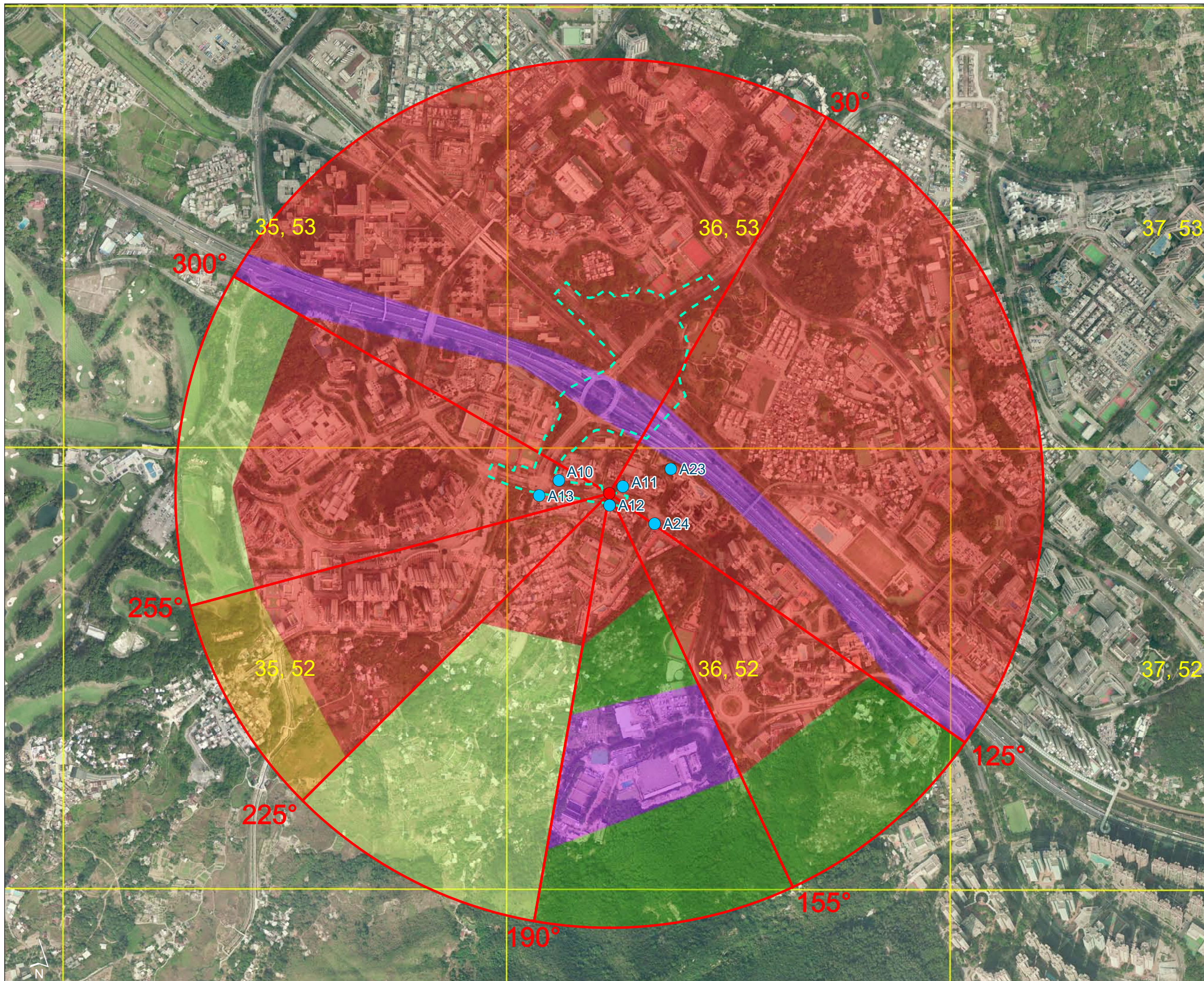
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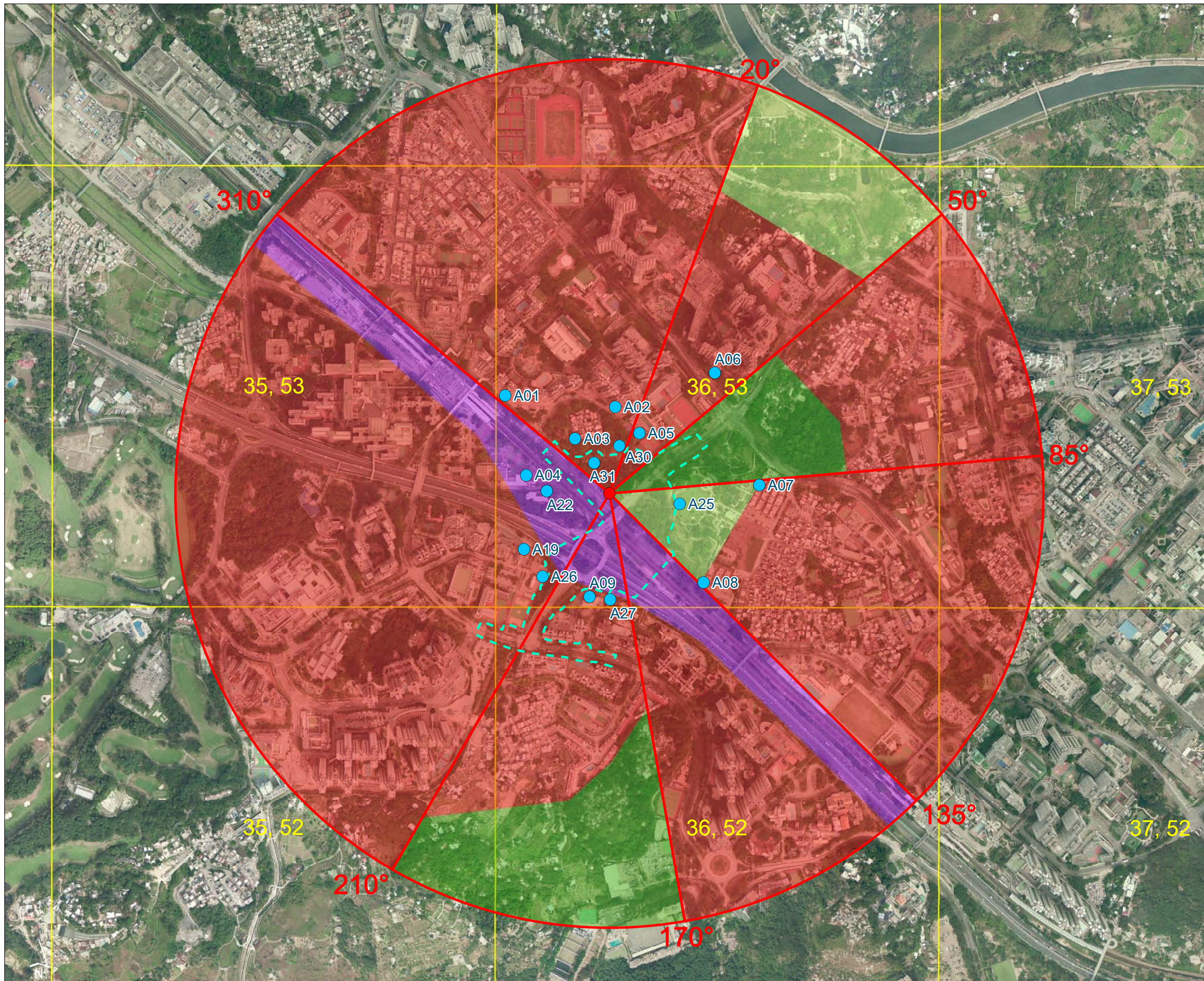
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Sectors of Land Use for PATH Grid 36, 52

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- Legend**
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 - ASR
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Rev	Description	By	Date



Project Title
IMPROVEMENT TO SO KWUN PO INTERCHANGE

Title
Sectors of Land Use for PATH Grid 36, 53

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