

The objective of this exercise is to establish some basic guidelines for the overall development from a size and density point of view. It is thought that a maximum area for the development should be restricted to an area of 12 square miles (sm) and a minimum area of 6 square miles. This equates to a population range of 50,000 to 120,000 people for the total development. This area is to contain all the required economic, support and habitation.

1. In the 120,000 projected population tab none of the 40% developed area lines result in a required Total Development Area of around 12 SM. In the 50% developed area lines the configurations a1, b1 and c1 all result in areas less than 12 SM. Comparable results in the 100,000 projected Population tab happen at both the 40% and 50% density coverage ratios in the a1, b1, c1 as well as the a1, a2, a3, b1, b2, b3 and c1, c2, c3 design configurations respectively. This indicates that there is more flexibility with a target population of 100,000 people for the development if the 12 SM maximum development area is imposed.

2. In the 50,000 projected population tab the only area if the maximum area is still limited at 12 SM then any of the configurations should work. Rather since this population is half of the real target population of 100,000 a limit of 6 SM should be used. Given this restriction only the 50% coverage density options work in the a1, a2, b1, b2, c1 and c2 design configurations work. This compares favorably to the patterns found to work in the 100,000 target population tab as well.

3. The walkability section of each tab indicate the anticipated distances different design configurations would impose on the residents in those areas. Notice that the sub(3) design configurations create the longest distances for anticipated travel at the ground level to major transportation nodes since these are the largest design configurations. The smaller design configurations indicated as sub(1) have much shorter distances. Where these give the desired results in smaller Total Development area they would be the preferred development pattern. These sub(1) and sub(2) development patterns appear to require less overall land for development, so they are much more preferred over the sub(3) patterns on those terms.

As the walkability index shows that shorter distances are preferred and those occur in the sub(1) and sub(2) design patterns so does the higher average story configurations of 8, 9 and 10 give the best overall efficiencies for total development area. In the 50% coverage development patterns, the Total Development area can be reduced to under 10 SM using the sub(1) and sub(2) design patterns in the 8, 9 and 10 story average configurations. Using these design patterns will give some greater variety in the size and heights of buildings. Under the 8 story average the land required for the development begins to get larger than the target of 12 SM.

4. The above analysis tends to indicate that to achieve an average height of 8 to 9 stories there can be at least three different development configurations, giving a range of flexibility between some low storied buildings mixed with typical mid-rise buildings of 10 to 15 stories and even a few 20 to 25 story buildings for emphasis.

While this analysis does not indicate exactly how these densities can be achieved with specific construction technologies, it does generally indicate that the structures will be built from more durable materials than wood framing and masonry bearing construction which is largely limited to 3 and 4 stories. A by-product of this indication is that the buildings will be built with substantial materials and will have life-spans of 50 years or longer without much effort, since the design criteria for mid-rise multi-story buildings are generally classified as Type I and Type II construction using steel and concrete as the major structural components.

One challenge will be to see how to enhance the design and delivery of these structures so that their costs do not override the efficiencies being strived for out of the planning configurations. If some guides can be created that help the construction methods to be more uniform and still innovative the overall development could benefit from some repeat construction methods and the efficiencies they should enjoy.

area	width	Length	Area (sf)	Factor (ac sf)	Area (ac)	Area (SM)	% cover	Cover (sf)	avg stories	Tot sf	sf gross / person	people / area	Density / SM	Planning Units / SM	Area (SM) for 120,000 People	Open Space Factor [+]	Total Development Area (SM)	Open or Low Density (SM) [†]	% Open area
a1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	10	13,200,000	2,900	4,552	38,453	8.448	3.12	4.5	14.04	10.92	78%
a2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	10	19,440,000	2,900	6,703	38,453	5.736	3.12	5	15.60	12.48	80%
a3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	10	34,560,000	2,900	11,917	38,453	3.227	3.12	5.5	17.16	14.04	82%
b1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	9	11,880,000	2,900	4,097	34,608	8.448	3.47	4	13.87	10.40	75%
b2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	9	17,496,000	2,900	6,033	34,608	5.736	3.47	4.5	15.60	12.14	78%
b3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	9	31,104,000	2,900	10,726	34,608	3.227	3.47	5	17.34	13.87	80%
c1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	8	10,560,000	2,900	3,641	30,762	8.448	3.90	3.5	13.65	9.75	71%
c2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	8	15,552,000	2,900	5,363	30,762	5.736	3.90	4	15.60	11.70	75%
c3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	8	27,648,000	2,900	9,534	30,762	3.227	3.90	4.5	17.55	13.65	78%
d1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	5	6,600,000	2,900	2,276	19,226	8.448	6.24	3	18.72	12.48	67%
d2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	5	9,720,000	2,900	3,352	19,226	5.736	6.24	3.5	21.84	15.60	71%
d3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	5	17,280,000	2,900	5,959	19,226	3.227	6.24	4	24.97	18.72	75%
e1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	4	5,280,000	2,900	1,821	15,381	8.448	7.80	2.5	19.50	11.70	60%
e2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	4	7,776,000	2,900	2,681	15,381	5.736	7.80	3	23.41	15.60	67%
e3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	4	13,824,000	2,900	4,767	15,381	3.227	7.80	3.5	27.31	19.50	71%

a1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	10	16,500,000	2,900	5,690	48,066	8.448	2.50	4.5	11.23	8.74	78%
a2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	10	24,300,000	2,900	8,379	48,066	5.736	2.50	5	12.48	9.99	80%
a3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	10	43,200,000	2,900	14,897	48,066	3.227	2.50	5.5	13.73	11.23	82%
b1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	9	14,850,000	2,900	5,121	43,260	8.448	2.77	4	11.10	8.32	75%
b2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	9	21,870,000	2,900	7,541	43,260	5.736	2.77	4.5	12.48	9.71	78%
b3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	9	38,880,000	2,900	13,407	43,260	3.227	2.77	5	13.87	11.10	80%
c1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	8	13,200,000	2,900	4,552	38,453	8.448	3.12	3.5	10.92	7.80	71%
c2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	8	19,440,000	2,900	6,703	38,453	5.736	3.12	4	12.48	9.36	75%
c3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	8	34,560,000	2,900	11,917	38,453	3.227	3.12	4.5	14.04	10.92	78%
d1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	5	8,250,000	2,900	2,845	24,033	8.448	4.99	3	14.98	9.99	67%
d2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	5	12,150,000	2,900	4,190	24,033	5.736	4.99	3.5	17.48	12.48	71%
d3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	5	21,600,000	2,900	7,448	24,033	3.227	4.99	4	19.97	14.98	75%
e1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	4	6,600,000	2,900	2,276	19,226	8.448	6.24	2.5	15.60	9.36	60%
e2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	4	9,720,000	2,900	3,352	19,226	5.736	6.24	3	18.72	12.48	67%
e3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	4	17,280,000	2,900	5,959	19,226	3.227	6.24	3.5	21.84	15.60	71%

[†] Open or Low density development includes agricultural, manufacturing, water treatment & reclamation, solar farms, open space preservation, desert reclamation, recreation. Calculated as a difference between the total Development Area and Area for People.

[+] Open Space Factor = multiplier of Area for People for Total Development Area. This creates area for additional surrounding low density and protected open area around the dense urban development area.

Optimized total land area of 12 square miles (SM). See patterns in 100,000 people and 50,000 people
 Land area GT 12 SM required to achieve desired total population of 120,000 or 100,000 people

Area / Person	2,900	Walkability			
		Dist (ft)	Stride (ft)	Strides	Dist (Mi)
Living	700				
Working	800	1,500	2.25	667	0.284
Gov Support	400	1,800	2.25	800	0.341
Cultural	100	2,200	2.25	978	0.417
Transport	900	2,400	2.25	1067	0.455
		2,700	2.25	1200	0.511
		3,600	2.25	1600	0.682
		9,600	2.25	4267	1.818 2,400 lf * 4 planning units (e3)
		10800	2.25	4800	2.045 2,700 lf * 4 planning units (a2)
		6000	2.25	2667	1.136 1,500 lf * 4 planning units (a1)

area	width	Length	Area (sf)	Factor (ac sf)	Area (ac)	Area (SM)	% cover	Cover (sf)	avg stories	Tot sf	sf gross / person	people / area	Density / SM	Planning Units / SM	Area (SM) for 120,000 People	Open Space Factor [+]	Total Development Area (SM)	Open or Low Density (SM) [*]	% Open area
a1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	10	13,200,000	2,900	4,552	38,453	8.448	2.60	4.5	11.70	9.10	78%
a2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	10	19,440,000	2,900	6,703	38,453	5.736	2.60	5	13.00	10.40	80%
a3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	10	34,560,000	2,900	11,917	38,453	3.227	2.60	5.5	14.30	11.70	82%
b1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	9	11,880,000	2,900	4,097	34,608	8.448	2.89	4	11.56	8.67	75%
b2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	9	17,496,000	2,900	6,033	34,608	5.736	2.89	4.5	13.00	10.11	78%
b3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	9	31,104,000	2,900	10,726	34,608	3.227	2.89	5	14.45	11.56	80%
c1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	8	10,560,000	2,900	3,641	30,762	8.448	3.25	3.5	11.38	8.13	71%
c2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	8	15,552,000	2,900	5,363	30,762	5.736	3.25	4	13.00	9.75	75%
c3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	8	27,648,000	2,900	9,534	30,762	3.227	3.25	4.5	14.63	11.38	78%
d1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	5	6,600,000	2,900	2,276	19,226	8.448	5.20	3	15.60	10.40	67%
d2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	5	9,720,000	2,900	3,352	19,226	5.736	5.20	3.5	18.20	13.00	71%
d3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	5	17,280,000	2,900	5,959	19,226	3.227	5.20	4	20.80	15.60	75%
e1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	4	5,280,000	2,900	1,821	15,381	8.448	6.50	2.5	16.25	9.75	60%
e2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	4	7,776,000	2,900	2,681	15,381	5.736	6.50	3	19.50	13.00	67%
e3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	4	13,824,000	2,900	4,767	15,381	3.227	6.50	3.5	22.76	16.25	71%

a1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	10	16,500,000	2,900	5,690	48,066	8.448	2.08	4.5	9.36	7.28	78%
a2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	10	24,300,000	2,900	8,379	48,066	5.736	2.08	5	10.40	8.32	80%
a3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	10	43,200,000	2,900	14,897	48,066	3.227	2.08	5.5	11.44	9.36	82%
b1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	9	14,850,000	2,900	5,121	43,260	8.448	2.31	4	9.25	6.93	75%
b2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	9	21,870,000	2,900	7,541	43,260	5.736	2.31	4.5	10.40	8.09	78%
b3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	9	38,880,000	2,900	13,407	43,260	3.227	2.31	5	11.56	9.25	80%
c1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	8	13,200,000	2,900	4,552	38,453	8.448	2.60	3.5	9.10	6.50	71%
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d3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	5	21,600,000	2,900	7,448	24,033	3.227	4.16	4	16.64	12.48	75%
e1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	4	6,600,000	2,900	2,276	19,226	8.448	5.20	2.5	13.00	7.80	60%
e2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	4	9,720,000	2,900	3,352	19,226	5.736	5.20	3	15.60	10.40	67%
e3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	4	17,280,000	2,900	5,959	19,226	3.227	5.20	3.5	18.20	13.00	71%

[*] Open or Low density development includes agricultural, manufacturing, water treatment & reclamation, solar farms, open space preservation, desert reclamation, recreation. Calculated as a difference between the total Development Area and Area for People.

[+] Open Space Factor = multiplier of Area for People for Total Development Area. This creates area for additional surrounding low density and protected open area around the dense urban development area.

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Working	800	1,500	2.25	667	0.284
Gov Support	400	1,800	2.25	800	0.341
Cultural	100	2,200	2.25	978	0.417
Transport	900	2,400	2.25	1067	0.455
		2,700	2.25	1200	0.511
		3,600	2.25	1600	0.682
		9,600	2.25	4267	1.818
		10800	2.25	4800	2.045
		6000	2.25	2667	1.136

2,400 lf * 4 planning units (e3)
2,700 lf * 4 planning units (a2)
1,500 lf * 4 planning units (a1)

Design Config	Width	Length	Area (sf)	Factor (ac sf)	Area (ac)	Area (SM)	% cover	Cover (sf)	avg stories	Tot sf	sf gross / person	people / area	Density / SM	Planning Units / SM	Area (SM) for 120,000 People	Open Space Factor [+]	Total Development Area (SM)	Open or Low Density (SM) [*]	% Open area
a1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	10	13,200,000	2,900	4,552	38,453	8.448	1.30	4.5	5.85	4.55	78%
a2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	10	19,440,000	2,900	6,703	38,453	5.736	1.30	5	6.50	5.20	80%
a3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	10	34,560,000	2,900	11,917	38,453	3.227	1.30	5.5	7.15	5.85	82%
b1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	9	11,880,000	2,900	4,097	34,608	8.448	1.44	4	5.78	4.33	75%
b2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	9	17,496,000	2,900	6,033	34,608	5.736	1.44	4.5	6.50	5.06	78%
b3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	9	31,104,000	2,900	10,726	34,608	3.227	1.44	5	7.22	5.78	80%
c1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	8	10,560,000	2,900	3,641	30,762	8.448	1.63	3.5	5.69	4.06	71%
c2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	8	15,552,000	2,900	5,363	30,762	5.736	1.63	4	6.50	4.88	75%
c3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	8	27,648,000	2,900	9,534	30,762	3.227	1.63	4.5	7.31	5.69	78%
d1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	5	6,600,000	2,900	2,276	19,226	8.448	2.60	3	7.80	5.20	67%
d2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	5	9,720,000	2,900	3,352	19,226	5.736	2.60	3.5	9.10	6.50	71%
d3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	5	17,280,000	2,900	5,959	19,226	3.227	2.60	4	10.40	7.80	75%
e1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	40%	1,320,000	4	5,280,000	2,900	1,821	15,381	8.448	3.25	2.5	8.13	4.88	60%
e2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	40%	1,944,000	4	7,776,000	2,900	2,681	15,381	5.736	3.25	3	9.75	6.50	67%
e3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	40%	3,456,000	4	13,824,000	2,900	4,767	15,381	3.227	3.25	3.5	11.38	8.13	71%

a1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	10	16,500,000	2,900	5,690	48,066	8.448	1.04	4.5	4.68	3.64	78%
a2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	10	24,300,000	2,900	8,379	48,066	5.736	1.04	5	5.20	4.16	80%
a3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	10	43,200,000	2,900	14,897	48,066	3.227	1.04	5.5	5.72	4.68	82%
b1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	9	14,850,000	2,900	5,121	43,260	8.448	1.16	4	4.62	3.47	75%
b2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	9	21,870,000	2,900	7,541	43,260	5.736	1.16	4.5	5.20	4.05	78%
b3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	9	38,880,000	2,900	13,407	43,260	3.227	1.16	5	5.78	4.62	80%
c1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	8	13,200,000	2,900	4,552	38,453	8.448	1.30	3.5	4.55	3.25	71%
c2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	8	19,440,000	2,900	6,703	38,453	5.736	1.30	4	5.20	3.90	75%
c3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	8	34,560,000	2,900	11,917	38,453	3.227	1.30	4.5	5.85	4.55	78%
d1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	5	8,250,000	2,900	2,845	24,033	8.448	2.08	3	6.24	4.16	67%
d2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	5	12,150,000	2,900	4,190	24,033	5.736	2.08	3.5	7.28	5.20	71%
d3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	5	21,600,000	2,900	7,448	24,033	3.227	2.08	4	8.32	6.24	75%
e1	1,500	2,200	3,300,000	43,560	75.75758	0.118371	50%	1,650,000	4	6,600,000	2,900	2,276	19,226	8.448	2.60	2.5	6.50	3.90	60%
e2	1,800	2,700	4,860,000	43,560	111.5702	0.174329	50%	2,430,000	4	9,720,000	2,900	3,352	19,226	5.736	2.60	3	7.80	5.20	67%
e3	2,400	3,600	8,640,000	43,560	198.3471	0.309917	50%	4,320,000	4	17,280,000	2,900	5,959	19,226	3.227	2.60	3.5	9.10	6.50	71%

[*] Open or Low density development includes agricultural, manufacturing, water treatment & reclamation, solar farms, open space preservation, desert reclamation, recreation. Calculated as a difference between the total Development Area and Area for People.

[+] Open Space Factor = multiplier of Area for People for Total Development Area. This creates area for additional surrounding low density and protected open area around the dense urban development area.

The design parameters for all these configurations will fit within 6 SM for the desired population since the basic level is 1/2 of the 100,000 target population..

Area / Person	2,900	Walkability			
		Dist (ft)	Stride (ft)	Strides	Dist (Mi)
Living	700				
Working	800	1,500	2.25	667	0.284
Gov Support	400	1,800	2.25	800	0.341
Cultural	100	2,200	2.25	978	0.417
Transport	900	2,400	2.25	1067	0.455
		2,700	2.25	1200	0.511
		3,600	2.25	1600	0.682
		9,600	2.25	4267	1.818
		10800	2.25	4800	2.045
		6000	2.25	2667	1.136

2,400 lf * 4 planning units (e3)
2,700 lf * 4 planning units (a2)
1,500 lf * 4 planning units (a1)