Southeast	0.9x	0.77	x	0.84	x	62.67	x	0.63	x	0.7	=	32.18	(77)
Southeast	0.9x	0.77	x	2.4	x	62.67	x	0.63	x	0.7	=	183.88	(77)
Southeast	0.9x	0.77	x	1.4	x	62.67	x	0.63	x	0.7	=	53.63	(77)
Southeast	0.9x	0.77	x	5.58	x	62.67	x	0.63	x	0.7	=	106.88	(77)
Southeast	0.9x	0.77	x	2.16	x	62.67	x	0.63	x	0.7	=	124.12	(77)
Southeast	0.9x	0.77	x	3.96	x	62.67	x	0.63	x	0.7	=	75.85	(77)
Southeast	0.9x	0.77	x	2.16	x	62.67	x	0.63	x	0.7	=	41.37	(77)
Southeast	0.9x	0.54	x	9.28	x	62.67	x	0.63	x	0.7	=	124.65	(77)
Southeast	0.9x	0.77	x	3.96	x	85.75	x	0.63	x	0.7	=	207.56	(77)
Southeast	0.9x	0.77	x	0.84	x	85.75	x	0.63	x	0.7	=	44.03	(77)
Southeast	0.9x	0.77	x	2.4	x	85.75	x	0.63	x	0.7	=	251.59	(77)
Southeast	0.9x	0.77	x	1.4	x	85.75	x	0.63	x	0.7	=	73.38	(77)
Southeast	0.9x	0.77	x	5.58	x	85.75	x	0.63	x	0.7	=	146.24	(77)
Southeast	0.9x	0.77	x	2.16	x	85.75	x	0.63	x	0.7	=	169.82	(77)
Southeast	0.9x	0.77	x	3.96	x	85.75	x	0.63	x	0.7	=	103.78	(77)
Southeast	0.9x	0.77	x	2.16	x	85.75	x	0.63	x	0.7	=	56.61	(77)
Southeast	0.9x	0.54	x	9.28	x	85.75	x	0.63	x	0.7	=	170.56	(77)
Southeast	0.9x	0.77	x	3.96	x	106.25	x	0.63	x	0.7	=	257.18	(77)
Southeast	0.9x	0.77	x	0.84	x	106.25	x	0.63	x	0.7	=	54.55	(77)
Southeast	0.9x	0.77	x	2.4	x	106.25	x	0.63	x	0.7	=	311.73	(77)
Southeast	0.9x	0.77	x	1.4	x	106.25	x	0.63	x	0.7	=	90.92	(77)
Southeast	0.9x	0.77	x	5.58	x	106.25	x	0.63	x	0.7	=	181.19	(77)
Southeast	0.9x	0.77	x	2.16	x	106.25	x	0.63	x	0.7	=	210.42	(77)
Southeast	0.9x	0.77	x	3.96	x	106.25	x	0.63	x	0.7	=	128.59	(77)
Southeast	0.9x	0.77	x	2.16	x	106.25	x	0.63	x	0.7	=	70.14	(77)
Southeast	0.9x	0.54	x	9.28	x	106.25	x	0.63	x	0.7	=	211.33	(77)
Southeast	0.9x	0.77	x	3.96	x	119.01	x	0.63	x	0.7	=	288.06	(77)
Southeast	0.9x	0.77	x	0.84	x	119.01	x	0.63	x	0.7	=	61.1	(77)
Southeast	0.9x	0.77	x	2.4	x	119.01	x	0.63	x	0.7	=	349.16	(77)
Southeast	0.9x	0.77	x	1.4	x	119.01	x	0.63	x	0.7	=	101.84	(77)
Southeast	0.9x	0.77	x	5.58	x	119.01	x	0.63	x	0.7	=	202.95	(77)
Southeast	0.9x	0.77	x	2.16	x	119.01	x	0.63	x	0.7	=	235.69	(77)
Southeast	0.9x	0.77	x	3.96	x	119.01	x	0.63	x	0.7	=	144.03	(77)
Southeast	0.9x	0.77	x	2.16	x	119.01	x	0.63	x	0.7	=	78.56	(77)
Southeast	0.9x	0.54	x	9.28	x	119.01	x	0.63	x	0.7	=	236.71	(77)
Southeast	0.9x	0.77	x	3.96	x	118.15	x	0.63	x	0.7	=	285.98	(77)
Southeast	0.9x	0.77	x	0.84	x	118.15	x	0.63	x	0.7	=	60.66	(77)
Southeast	0.9x	0.77	x	2.4	x	118.15	x	0.63	x	0.7	=	346.64	(77)
Southeast	0.9x	0.77	x	1.4	x	118.15	x	0.63	x	0.7	=	101.1	(77)
Southeast	0.9x	0.77	x	5.58	x	118.15	x	0.63	x	0.7	=	201.48	(77)
Southeast	0.9x	0.77	x	2.16	x	118.15	x	0.63	x	0.7	=	233.98	(77)

Southeast	0.9x	0.77	x	3.96	x	118.15	x	0.63	x	0.7	=	142.99	(77)
Southeast	0.9x	0.77	x	2.16	x	118.15	x	0.63	x	0.7	=	77.99	(77)
Southeast	0.9x	0.54	x	9.28	x	118.15	x	0.63	x	0.7	=	234.99	(77)
Southeast	0.9x	0.77	x	3.96	x	113.91	x	0.63	x	0.7	=	275.71	(77)
Southeast	0.9x	0.77	x	0.84	x	113.91	x	0.63	x	0.7	=	58.48	(77)
Southeast	0.9x	0.77	x	2.4	x	113.91	x	0.63	x	0.7	=	334.2	(77)
Southeast	0.9x	0.77	x	1.4	x	113.91	x	0.63	x	0.7	=	97.47	(77)
Southeast	0.9x	0.77	x	5.58	x	113.91	x	0.63	x	0.7	=	194.25	(77)
Southeast	0.9x	0.77	x	2.16	x	113.91	x	0.63	x	0.7	=	225.58	(77)
Southeast	0.9x	0.77	x	3.96	x	113.91	x	0.63	x	0.7	=	137.86	(77)
Southeast	0.9x	0.77	x	2.16	x	113.91	x	0.63	x	0.7	=	75.19	(77)
Southeast	0.9x	0.54	x	9.28	x	113.91	x	0.63	x	0.7	=	226.56	(77)
Southeast	0.9x	0.77	x	3.96	x	104.39	x	0.63	x	0.7	=	252.67	(77)
Southeast	0.9x	0.77	x	0.84	x	104.39	x	0.63	x	0.7	=	53.6	(77)
Southeast	0.9x	0.77	x	2.4	x	104.39	x	0.63	x	0.7	=	306.27	(77)
Southeast	0.9x	0.77	x	1.4	x	104.39	x	0.63	x	0.7	=	89.33	(77)
Southeast	0.9x	0.77	x	5.58	x	104.39	x	0.63	x	0.7	=	178.02	(77)
Southeast	0.9x	0.77	x	2.16	x	104.39	x	0.63	x	0.7	=	206.73	(77)
Southeast	0.9x	0.77	x	3.96	x	104.39	x	0.63	x	0.7	=	126.34	(77)
Southeast	0.9x	0.77	x	2.16	x	104.39	x	0.63	x	0.7	=	68.91	(77)
Southeast	0.9x	0.54	x	9.28	x	104.39	x	0.63	x	0.7	=	207.63	(77)
Southeast	0.9x	0.77	x	3.96	x	92.85	x	0.63	x	0.7	=	224.74	(77)
Southeast	0.9x	0.77	x	0.84	x	92.85	x	0.63	x	0.7	=	47.67	(77)
Southeast	0.9x	0.77	x	2.4	x	92.85	x	0.63	x	0.7	=	272.42	(77)
Southeast	0.9x	0.77	x	1.4	x	92.85	x	0.63	x	0.7	=	79.45	(77)
Southeast	0.9x	0.77	x	5.58	x	92.85	x	0.63	x	0.7	=	158.34	(77)
Southeast	0.9x	0.77	x	2.16	x	92.85	x	0.63	x	0.7	=	183.88	(77)
Southeast	0.9x	0.77	x	3.96	x	92.85	x	0.63	x	0.7	=	112.37	(77)
Southeast	0.9x	0.77	x	2.16	x	92.85	x	0.63	x	0.7	=	61.29	(77)
Southeast	0.9x	0.54	x	9.28	x	92.85	x	0.63	x	0.7	=	184.68	(77)
Southeast	0.9x	0.77	x	3.96	x	69.27	x	0.63	x	0.7	=	167.66	(77)
Southeast	0.9x	0.77	x	0.84	x	69.27	x	0.63	x	0.7	=	35.56	(77)
Southeast	0.9x	0.77	x	2.4	x	69.27	x	0.63	x	0.7	=	203.22	(77)
Southeast	0.9x	0.77	x	1.4	x	69.27	x	0.63	x	0.7	=	59.27	(77)
Southeast	0.9x	0.77	x	5.58	x	69.27	x	0.63	x	0.7	=	118.12	(77)
Southeast	0.9x	0.77	x	2.16	x	69.27	x	0.63	x	0.7	=	137.18	(77)
Southeast	0.9x	0.77	x	3.96	x	69.27	x	0.63	x	0.7	=	83.83	(77)
Southeast	0.9x	0.77	x	2.16	x	69.27	x	0.63	x	0.7	=	45.73	(77)
Southeast	0.9x	0.54	x	9.28	x	69.27	x	0.63	x	0.7	=	137.77	(77)
Southeast	0.9x	0.77	x	3.96	x	44.07	x	0.63	x	0.7	=	106.67	(77)
Southeast	0.9x	0.77	x	0.84	x	44.07	x	0.63	x	0.7	=	22.63	(77)

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Southeast	0.9x	0.77	x	2.4	x	44.07	x	0.63	x	0.7	=	129.3	(77)
Southeast	0.9x	0.77	x	1.4	x	44.07	x	0.63	x	0.7	=	37.71	(77)
Southeast	0.9x	0.77	x	5.58	x	44.07	x	0.63	x	0.7	=	75.15	(77)
Southeast	0.9x	0.77	x	2.16	x	44.07	x	0.63	x	0.7	=	87.28	(77)
Southeast	0.9x	0.77	x	3.96	x	44.07	x	0.63	x	0.7	=	53.34	(77)
Southeast	0.9x	0.77	x	2.16	x	44.07	x	0.63	x	0.7	=	29.09	(77)
Southeast	0.9x	0.54	x	9.28	x	44.07	x	0.63	x	0.7	=	87.65	(77)
Southeast	0.9x	0.77	x	3.96	x	31.49	x	0.63	x	0.7	=	76.21	(77)
Southeast	0.9x	0.77	x	0.84	x	31.49	x	0.63	x	0.7	=	16.17	(77)
Southeast	0.9x	0.77	x	2.4	x	31.49	x	0.63	x	0.7	=	92.38	(77)
Southeast	0.9x	0.77	x	1.4	x	31.49	x	0.63	x	0.7	=	26.94	(77)
Southeast	0.9x	0.77	x	5.58	x	31.49	x	0.63	x	0.7	=	53.7	(77)
Southeast	0.9x	0.77	x	2.16	x	31.49	x	0.63	x	0.7	=	62.36	(77)
Southeast	0.9x	0.77	x	3.96	x	31.49	x	0.63	x	0.7	=	38.11	(77)
Southeast	0.9x	0.77	x	2.16	x	31.49	x	0.63	x	0.7	=	20.79	(77)
Southeast	0.9x	0.54	x	9.28	x	31.49	x	0.63	x	0.7	=	62.63	(77)
South	0.9x	0.77	x	1.54	x	46.75	x	0.63	x	0.7	=	44.01	(78)
South	0.9x	0.77	x	1.54	x	76.57	x	0.63	x	0.7	=	72.07	(78)
South	0.9x	0.77	x	1.54	x	97.53	x	0.63	x	0.7	=	91.81	(78)
South	0.9x	0.77	x	1.54	x	110.23	x	0.63	x	0.7	=	103.76	(78)
South	0.9x	0.77	x	1.54	x	114.87	x	0.63	x	0.7	=	108.13	(78)
South	0.9x	0.77	x	1.54	x	110.55	x	0.63	x	0.7	=	104.06	(78)
South	0.9x	0.77	x	1.54	x	108.01	x	0.63	x	0.7	=	101.67	(78)
South	0.9x	0.77	x	1.54	x	104.89	x	0.63	x	0.7	=	98.74	(78)
South	0.9x	0.77	x	1.54	x	101.89	x	0.63	x	0.7	=	95.9	(78)
South	0.9x	0.77	x	1.54	x	82.59	x	0.63	x	0.7	=	77.74	(78)
South	0.9x	0.77	x	1.54	x	55.42	x	0.63	x	0.7	=	52.16	(78)
South	0.9x	0.77	x	1.54	x	40.4	x	0.63	x	0.7	=	38.03	(78)
Southwest	0.9x	0.54	x	13.05	x	36.79		0.63	x	0.7	=	102.91	(79)
Southwest	0.9x	0.77	x	1.2	x	36.79		0.63	x	0.7	=	40.48	(79)
Southwest	0.9x	0.77	x	1.56	x	36.79		0.63	x	0.7	=	17.54	(79)
Southwest	0.9x	0.77	x	0.91	x	36.79		0.63	x	0.7	=	30.7	(79)
Southwest	0.9x	0.77	x	3.75	x	36.79		0.63	x	0.7	=	42.17	(79)
Southwest	0.9x	0.54	x	2.21	x	36.79		0.63	x	0.7	=	17.43	(79)
Southwest	0.9x	0.54	x	3.4	x	36.79		0.63	x	0.7	=	26.81	(79)
Southwest	0.9x	0.54	x	13.05	x	62.67		0.63	x	0.7	=	175.29	(79)
Southwest	0.9x	0.77	x	1.2	x	62.67		0.63	x	0.7	=	68.95	(79)
Southwest	0.9x	0.77	x	1.56	x	62.67		0.63	x	0.7	=	29.88	(79)
Southwest	0.9x	0.77	x	0.91	x	62.67		0.63	x	0.7	=	52.29	(79)
Southwest	0.9x	0.77	x	3.75	x	62.67		0.63	x	0.7	=	71.83	(79)
Southwest	0.9x	0.54	x	2.21	x	62.67		0.63	x	0.7	=	29.69	(79)

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Southwest0.9x	0.54	x	3.4	x	62.67	0.63	x	0.7	=	45.67	(79)
Southwest0.9x	0.54	x	13.05	x	85.75	0.63	x	0.7	=	239.85	(79)
Southwest0.9x	0.77	x	1.2	x	85.75	0.63	x	0.7	=	94.35	(79)
Southwest0.9x	0.77	x	1.56	x	85.75	0.63	x	0.7	=	40.88	(79)
Southwest0.9x	0.77	x	0.91	x	85.75	0.63	x	0.7	=	71.55	(79)
Southwest0.9x	0.77	x	3.75	x	85.75	0.63	x	0.7	=	98.28	(79)
Southwest0.9x	0.54	x	2.21	x	85.75	0.63	x	0.7	=	40.62	(79)
Southwest0.9x	0.54	x	3.4	x	85.75	0.63	x	0.7	=	62.49	(79)
Southwest0.9x	0.54	x	13.05	x	106.25	0.63	x	0.7	=	297.18	(79)
Southwest0.9x	0.77	x	1.2	x	106.25	0.63	x	0.7	=	116.9	(79)
Southwest0.9x	0.77	x	1.56	x	106.25	0.63	x	0.7	=	50.66	(79)
Southwest0.9x	0.77	x	0.91	x	106.25	0.63	x	0.7	=	88.65	(79)
Southwest0.9x	0.77	x	3.75	x	106.25	0.63	x	0.7	=	121.77	(79)
Southwest0.9x	0.54	x	2.21	x	106.25	0.63	x	0.7	=	50.33	(79)
Southwest0.9x	0.54	x	3.4	x	106.25	0.63	x	0.7	=	77.43	(79)
Southwest0.9x	0.54	x	13.05	x	119.01	0.63	x	0.7	=	332.87	(79)
Southwest0.9x	0.77	x	1.2	x	119.01	0.63	x	0.7	=	130.94	(79)
Southwest0.9x	0.77	x	1.56	x	119.01	0.63	x	0.7	=	56.74	(79)
Southwest0.9x	0.77	x	0.91	x	119.01	0.63	x	0.7	=	99.29	(79)
Southwest0.9x	0.77	x	3.75	x	119.01	0.63	x	0.7	=	136.39	(79)
Southwest0.9x	0.54	x	2.21	x	119.01	0.63	x	0.7	=	56.37	(79)
Southwest0.9x	0.54	x	3.4	x	119.01	0.63	x	0.7	=	86.72	(79)
Southwest0.9x	0.54	x	13.05	x	118.15	0.63	x	0.7	=	330.46	(79)
Southwest0.9x	0.77	x	1.2	x	118.15	0.63	x	0.7	=	129.99	(79)
Southwest0.9x	0.77	x	1.56	x	118.15	0.63	x	0.7	=	56.33	(79)
Southwest0.9x	0.77	x	0.91	x	118.15	0.63	x	0.7	=	98.58	(79)
Southwest0.9x	0.77	x	3.75	x	118.15	0.63	x	0.7	=	135.41	(79)
Southwest0.9x	0.54	x	2.21	x	118.15	0.63	x	0.7	=	55.96	(79)
Southwest0.9x	0.54	x	3.4	x	118.15	0.63	x	0.7	=	86.1	(79)
Southwest0.9x	0.54	x	13.05	x	113.91	0.63	x	0.7	=	318.6	(79)
Southwest0.9x	0.77	x	1.2	x	113.91	0.63	x	0.7	=	125.32	(79)
Southwest0.9x	0.77	x	1.56	x	113.91	0.63	x	0.7	=	54.31	(79)
Southwest0.9x	0.77	x	0.91	x	113.91	0.63	x	0.7	=	95.04	(79)
Southwest0.9x	0.77	x	3.75	x	113.91	0.63	x	0.7	=	130.55	(79)
Southwest0.9x	0.54	x	2.21	x	113.91	0.63	x	0.7	=	53.95	(79)
Southwest0.9x	0.54	x	3.4	x	113.91	0.63	x	0.7	=	83.01	(79)
Southwest0.9x	0.54	x	13.05	x	104.39	0.63	x	0.7	=	291.98	(79)
Southwest0.9x	0.77	x	1.2	x	104.39	0.63	x	0.7	=	114.85	(79)
Southwest0.9x	0.77	x	1.56	x	104.39	0.63	x	0.7	=	49.77	(79)
Southwest0.9x	0.77	x	0.91	x	104.39	0.63	x	0.7	=	87.1	(79)
Southwest0.9x	0.77	x	3.75	x	104.39	0.63	x	0.7	=	119.64	(79)

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Southwest	0.9x	0.54	x	2.21	x	104.39		0.63	x	0.7	=	49.45	(79)
Southwest	0.9x	0.54	x	3.4	x	104.39		0.63	x	0.7	=	76.07	(79)
Southwest	0.9x	0.54	x	13.05	x	92.85		0.63	x	0.7	=	259.7	(79)
Southwest	0.9x	0.77	x	1.2	x	92.85		0.63	x	0.7	=	102.16	(79)
Southwest	0.9x	0.77	x	1.56	x	92.85		0.63	x	0.7	=	44.27	(79)
Southwest	0.9x	0.77	x	0.91	x	92.85		0.63	x	0.7	=	77.47	(79)
Southwest	0.9x	0.77	x	3.75	x	92.85		0.63	x	0.7	=	106.41	(79)
Southwest	0.9x	0.54	x	2.21	x	92.85		0.63	x	0.7	=	43.98	(79)
Southwest	0.9x	0.54	x	3.4	x	92.85		0.63	x	0.7	=	67.66	(79)
Southwest	0.9x	0.54	x	13.05	x	69.27		0.63	x	0.7	=	193.74	(79)
Southwest	0.9x	0.77	x	1.2	x	69.27		0.63	x	0.7	=	76.21	(79)
Southwest	0.9x	0.77	x	1.56	x	69.27		0.63	x	0.7	=	33.02	(79)
Southwest	0.9x	0.77	x	0.91	x	69.27		0.63	x	0.7	=	57.79	(79)
Southwest	0.9x	0.77	x	3.75	x	69.27		0.63	x	0.7	=	79.38	(79)
Southwest	0.9x	0.54	x	2.21	x	69.27		0.63	x	0.7	=	32.81	(79)
Southwest	0.9x	0.54	x	3.4	x	69.27		0.63	x	0.7	=	50.48	(79)
Southwest	0.9x	0.54	x	13.05	x	44.07		0.63	x	0.7	=	123.26	(79)
Southwest	0.9x	0.77	x	1.2	x	44.07		0.63	x	0.7	=	48.49	(79)
Southwest	0.9x	0.77	x	1.56	x	44.07		0.63	x	0.7	=	21.01	(79)
Southwest	0.9x	0.77	x	0.91	x	44.07		0.63	x	0.7	=	36.77	(79)
Southwest	0.9x	0.77	x	3.75	x	44.07		0.63	x	0.7	=	50.51	(79)
Southwest	0.9x	0.54	x	2.21	x	44.07		0.63	x	0.7	=	20.87	(79)
Southwest	0.9x	0.54	x	3.4	x	44.07		0.63	x	0.7	=	32.11	(79)
Southwest	0.9x	0.54	x	13.05	x	31.49		0.63	x	0.7	=	88.07	(79)
Southwest	0.9x	0.77	x	1.2	x	31.49		0.63	x	0.7	=	34.64	(79)
Southwest	0.9x	0.77	x	1.56	x	31.49		0.63	x	0.7	=	15.01	(79)
Southwest	0.9x	0.77	x	0.91	x	31.49		0.63	x	0.7	=	26.27	(79)
Southwest	0.9x	0.77	x	3.75	x	31.49		0.63	x	0.7	=	36.09	(79)
Southwest	0.9x	0.54	x	2.21	x	31.49		0.63	x	0.7	=	14.91	(79)
Southwest	0.9x	0.54	x	3.4	x	31.49		0.63	x	0.7	=	22.95	(79)
Northwest	0.9x	0.77	x	12.18	x	11.28	x	0.63	x	0.7	=	42	(81)
Northwest	0.9x	0.77	x	20.01	x	11.28	x	0.63	x	0.7	=	69	(81)
Northwest	0.9x	0.54	x	3.77	x	11.28	x	0.63	x	0.7	=	27.35	(81)
Northwest	0.9x	0.54	x	3.48	x	11.28	x	0.63	x	0.7	=	8.42	(81)
Northwest	0.9x	0.77	x	2.16	x	11.28	x	0.63	x	0.7	=	7.45	(81)
Northwest	0.9x	0.77	x	2.4	x	11.28	x	0.63	x	0.7	=	24.83	(81)
Northwest	0.9x	0.77	x	3.6	x	11.28	x	0.63	x	0.7	=	12.41	(81)
Northwest	0.9x	0.77	x	2.86	x	11.28	x	0.63	x	0.7	=	9.86	(81)
Northwest	0.9x	0.77	x	0.5	x	11.28	x	0.63	x	0.7	=	1.72	(81)
Northwest	0.9x	0.77	x	0.7	x	11.28	x	0.63	x	0.7	=	2.41	(81)
Northwest	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	8.69	(81)

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Northwest	0.9x	0.77	x	1.44	x	11.28	x	0.63	x	0.7	=	9.93	(81)
Northwest	0.9x	0.77	x	12.18	x	22.97	x	0.63	x	0.7	=	85.49	(81)
Northwest	0.9x	0.77	x	20.01	x	22.97	x	0.63	x	0.7	=	140.45	(81)
Northwest	0.9x	0.54	x	3.77	x	22.97	x	0.63	x	0.7	=	55.67	(81)
Northwest	0.9x	0.54	x	3.48	x	22.97	x	0.63	x	0.7	=	17.13	(81)
Northwest	0.9x	0.77	x	2.16	x	22.97	x	0.63	x	0.7	=	15.16	(81)
Northwest	0.9x	0.77	x	2.4	x	22.97	x	0.63	x	0.7	=	50.54	(81)
Northwest	0.9x	0.77	x	3.6	x	22.97	x	0.63	x	0.7	=	25.27	(81)
Northwest	0.9x	0.77	x	2.86	x	22.97	x	0.63	x	0.7	=	20.07	(81)
Northwest	0.9x	0.77	x	0.5	x	22.97	x	0.63	x	0.7	=	3.51	(81)
Northwest	0.9x	0.77	x	0.7	x	22.97	x	0.63	x	0.7	=	4.91	(81)
Northwest	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	17.69	(81)
Northwest	0.9x	0.77	x	1.44	x	22.97	x	0.63	x	0.7	=	20.21	(81)
Northwest	0.9x	0.77	x	12.18	x	41.38	x	0.63	x	0.7	=	154.03	(81)
Northwest	0.9x	0.77	x	20.01	x	41.38	x	0.63	x	0.7	=	253.04	(81)
Northwest	0.9x	0.54	x	3.77	x	41.38	x	0.63	x	0.7	=	100.3	(81)
Northwest	0.9x	0.54	x	3.48	x	41.38	x	0.63	x	0.7	=	30.86	(81)
Northwest	0.9x	0.77	x	2.16	x	41.38	x	0.63	x	0.7	=	27.32	(81)
Northwest	0.9x	0.77	x	2.4	x	41.38	x	0.63	x	0.7	=	91.05	(81)
Northwest	0.9x	0.77	x	3.6	x	41.38	x	0.63	x	0.7	=	45.53	(81)
Northwest	0.9x	0.77	x	2.86	x	41.38	x	0.63	x	0.7	=	36.17	(81)
Northwest	0.9x	0.77	x	0.5	x	41.38	x	0.63	x	0.7	=	6.32	(81)
Northwest	0.9x	0.77	x	0.7	x	41.38	x	0.63	x	0.7	=	8.85	(81)
Northwest	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	31.87	(81)
Northwest	0.9x	0.77	x	1.44	x	41.38	x	0.63	x	0.7	=	36.42	(81)
Northwest	0.9x	0.77	x	12.18	x	67.96	x	0.63	x	0.7	=	252.96	(81)
Northwest	0.9x	0.77	x	20.01	x	67.96	x	0.63	x	0.7	=	415.57	(81)
Northwest	0.9x	0.54	x	3.77	x	67.96	x	0.63	x	0.7	=	164.73	(81)
Northwest	0.9x	0.54	x	3.48	x	67.96	x	0.63	x	0.7	=	50.69	(81)
Northwest	0.9x	0.77	x	2.16	x	67.96	x	0.63	x	0.7	=	44.86	(81)
Northwest	0.9x	0.77	x	2.4	x	67.96	x	0.63	x	0.7	=	149.53	(81)
Northwest	0.9x	0.77	x	3.6	x	67.96	x	0.63	x	0.7	=	74.77	(81)
Northwest	0.9x	0.77	x	2.86	x	67.96	x	0.63	x	0.7	=	59.4	(81)
Northwest	0.9x	0.77	x	0.5	x	67.96	x	0.63	x	0.7	=	10.38	(81)
Northwest	0.9x	0.77	x	0.7	x	67.96	x	0.63	x	0.7	=	14.54	(81)
Northwest	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	52.34	(81)
Northwest	0.9x	0.77	x	1.44	x	67.96	x	0.63	x	0.7	=	59.81	(81)
Northwest	0.9x	0.77	x	12.18	x	91.35	x	0.63	x	0.7	=	340.02	(81)
Northwest	0.9x	0.77	x	20.01	x	91.35	x	0.63	x	0.7	=	558.61	(81)
Northwest	0.9x	0.54	x	3.77	x	91.35	x	0.63	x	0.7	=	221.43	(81)
Northwest	0.9x	0.54	x	3.48	x	91.35	x	0.63	x	0.7	=	68.13	(81)

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Northwest 0.9x	0.77	x	2.16	x	91.35	x	0.63	x	0.7	=	60.3	(81)
Northwest 0.9x	0.77	x	2.4	x	91.35	x	0.63	x	0.7	=	201	(81)
Northwest 0.9x	0.77	x	3.6	x	91.35	x	0.63	x	0.7	=	100.5	(81)
Northwest 0.9x	0.77	x	2.86	x	91.35	x	0.63	x	0.7	=	79.84	(81)
Northwest 0.9x	0.77	x	0.5	x	91.35	x	0.63	x	0.7	=	13.96	(81)
Northwest 0.9x	0.77	x	0.7	x	91.35	x	0.63	x	0.7	=	19.54	(81)
Northwest 0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	70.35	(81)
Northwest 0.9x	0.77	x	1.44	x	91.35	x	0.63	x	0.7	=	80.4	(81)
Northwest 0.9x	0.77	x	12.18	x	97.38	x	0.63	x	0.7	=	362.5	(81)
Northwest 0.9x	0.77	x	20.01	x	97.38	x	0.63	x	0.7	=	595.54	(81)
Northwest 0.9x	0.54	x	3.77	x	97.38	x	0.63	x	0.7	=	236.06	(81)
Northwest 0.9x	0.54	x	3.48	x	97.38	x	0.63	x	0.7	=	72.63	(81)
Northwest 0.9x	0.77	x	2.16	x	97.38	x	0.63	x	0.7	=	64.29	(81)
Northwest 0.9x	0.77	x	2.4	x	97.38	x	0.63	x	0.7	=	214.29	(81)
Northwest 0.9x	0.77	x	3.6	x	97.38	x	0.63	x	0.7	=	107.14	(81)
Northwest 0.9x	0.77	x	2.86	x	97.38	x	0.63	x	0.7	=	85.12	(81)
Northwest 0.9x	0.77	x	0.5	x	97.38	x	0.63	x	0.7	=	14.88	(81)
Northwest 0.9x	0.77	x	0.7	x	97.38	x	0.63	x	0.7	=	20.83	(81)
Northwest 0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	75	(81)
Northwest 0.9x	0.77	x	1.44	x	97.38	x	0.63	x	0.7	=	85.71	(81)
Northwest 0.9x	0.77	x	12.18	x	91.1	x	0.63	x	0.7	=	339.11	(81)
Northwest 0.9x	0.77	x	20.01	x	91.1	x	0.63	x	0.7	=	557.11	(81)
Northwest 0.9x	0.54	x	3.77	x	91.1	x	0.63	x	0.7	=	220.83	(81)
Northwest 0.9x	0.54	x	3.48	x	91.1	x	0.63	x	0.7	=	67.95	(81)
Northwest 0.9x	0.77	x	2.16	x	91.1	x	0.63	x	0.7	=	60.14	(81)
Northwest 0.9x	0.77	x	2.4	x	91.1	x	0.63	x	0.7	=	200.46	(81)
Northwest 0.9x	0.77	x	3.6	x	91.1	x	0.63	x	0.7	=	100.23	(81)
Northwest 0.9x	0.77	x	2.86	x	91.1	x	0.63	x	0.7	=	79.63	(81)
Northwest 0.9x	0.77	x	0.5	x	91.1	x	0.63	x	0.7	=	13.92	(81)
Northwest 0.9x	0.77	x	0.7	x	91.1	x	0.63	x	0.7	=	19.49	(81)
Northwest 0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	70.16	(81)
Northwest 0.9x	0.77	x	1.44	x	91.1	x	0.63	x	0.7	=	80.18	(81)
Northwest 0.9x	0.77	x	12.18	x	72.63	x	0.63	x	0.7	=	270.34	(81)
Northwest 0.9x	0.77	x	20.01	x	72.63	x	0.63	x	0.7	=	444.14	(81)
Northwest 0.9x	0.54	x	3.77	x	72.63	x	0.63	x	0.7	=	176.05	(81)
Northwest 0.9x	0.54	x	3.48	x	72.63	x	0.63	x	0.7	=	54.17	(81)
Northwest 0.9x	0.77	x	2.16	x	72.63	x	0.63	x	0.7	=	47.94	(81)
Northwest 0.9x	0.77	x	2.4	x	72.63	x	0.63	x	0.7	=	159.81	(81)
Northwest 0.9x	0.77	x	3.6	x	72.63	x	0.63	x	0.7	=	79.9	(81)
Northwest 0.9x	0.77	x	2.86	x	72.63	x	0.63	x	0.7	=	63.48	(81)
Northwest 0.9x	0.77	x	0.5	x	72.63	x	0.63	x	0.7	=	11.1	(81)

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Northwest 0.9x	0.77	x	0.7	x	72.63	x	0.63	x	0.7	=	15.54	(81)
Northwest 0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	55.93	(81)
Northwest 0.9x	0.77	x	1.44	x	72.63	x	0.63	x	0.7	=	63.92	(81)
Northwest 0.9x	0.77	x	12.18	x	50.42	x	0.63	x	0.7	=	187.68	(81)
Northwest 0.9x	0.77	x	20.01	x	50.42	x	0.63	x	0.7	=	308.34	(81)
Northwest 0.9x	0.54	x	3.77	x	50.42	x	0.63	x	0.7	=	122.22	(81)
Northwest 0.9x	0.54	x	3.48	x	50.42	x	0.63	x	0.7	=	37.61	(81)
Northwest 0.9x	0.77	x	2.16	x	50.42	x	0.63	x	0.7	=	33.28	(81)
Northwest 0.9x	0.77	x	2.4	x	50.42	x	0.63	x	0.7	=	110.95	(81)
Northwest 0.9x	0.77	x	3.6	x	50.42	x	0.63	x	0.7	=	55.47	(81)
Northwest 0.9x	0.77	x	2.86	x	50.42	x	0.63	x	0.7	=	44.07	(81)
Northwest 0.9x	0.77	x	0.5	x	50.42	x	0.63	x	0.7	=	7.7	(81)
Northwest 0.9x	0.77	x	0.7	x	50.42	x	0.63	x	0.7	=	10.79	(81)
Northwest 0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	38.83	(81)
Northwest 0.9x	0.77	x	1.44	x	50.42	x	0.63	x	0.7	=	44.38	(81)
Northwest 0.9x	0.77	x	12.18	x	28.07	x	0.63	x	0.7	=	104.48	(81)
Northwest 0.9x	0.77	x	20.01	x	28.07	x	0.63	x	0.7	=	171.64	(81)
Northwest 0.9x	0.54	x	3.77	x	28.07	x	0.63	x	0.7	=	68.04	(81)
Northwest 0.9x	0.54	x	3.48	x	28.07	x	0.63	x	0.7	=	20.93	(81)
Northwest 0.9x	0.77	x	2.16	x	28.07	x	0.63	x	0.7	=	18.53	(81)
Northwest 0.9x	0.77	x	2.4	x	28.07	x	0.63	x	0.7	=	61.76	(81)
Northwest 0.9x	0.77	x	3.6	x	28.07	x	0.63	x	0.7	=	30.88	(81)
Northwest 0.9x	0.77	x	2.86	x	28.07	x	0.63	x	0.7	=	24.53	(81)
Northwest 0.9x	0.77	x	0.5	x	28.07	x	0.63	x	0.7	=	4.29	(81)
Northwest 0.9x	0.77	x	0.7	x	28.07	x	0.63	x	0.7	=	6	(81)
Northwest 0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	21.62	(81)
Northwest 0.9x	0.77	x	1.44	x	28.07	x	0.63	x	0.7	=	24.7	(81)
Northwest 0.9x	0.77	x	12.18	x	14.2	x	0.63	x	0.7	=	52.85	(81)
Northwest 0.9x	0.77	x	20.01	x	14.2	x	0.63	x	0.7	=	86.82	(81)
Northwest 0.9x	0.54	x	3.77	x	14.2	x	0.63	x	0.7	=	34.41	(81)
Northwest 0.9x	0.54	x	3.48	x	14.2	x	0.63	x	0.7	=	10.59	(81)
Northwest 0.9x	0.77	x	2.16	x	14.2	x	0.63	x	0.7	=	9.37	(81)
Northwest 0.9x	0.77	x	2.4	x	14.2	x	0.63	x	0.7	=	31.24	(81)
Northwest 0.9x	0.77	x	3.6	x	14.2	x	0.63	x	0.7	=	15.62	(81)
Northwest 0.9x	0.77	x	2.86	x	14.2	x	0.63	x	0.7	=	12.41	(81)
Northwest 0.9x	0.77	x	0.5	x	14.2	x	0.63	x	0.7	=	2.17	(81)
Northwest 0.9x	0.77	x	0.7	x	14.2	x	0.63	x	0.7	=	3.04	(81)
Northwest 0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	10.93	(81)
Northwest 0.9x	0.77	x	1.44	x	14.2	x	0.63	x	0.7	=	12.5	(81)
Northwest 0.9x	0.77	x	12.18	x	9.21	x	0.63	x	0.7	=	34.3	(81)
Northwest 0.9x	0.77	x	20.01	x	9.21	x	0.63	x	0.7	=	56.35	(81)

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Northwest 0.9x	0.54	x	3.77	x	9.21	x	0.63	x	0.7	=	22.34	(81)
Northwest 0.9x	0.54	x	3.48	x	9.21	x	0.63	x	0.7	=	6.87	(81)
Northwest 0.9x	0.77	x	2.16	x	9.21	x	0.63	x	0.7	=	6.08	(81)
Northwest 0.9x	0.77	x	2.4	x	9.21	x	0.63	x	0.7	=	20.28	(81)
Northwest 0.9x	0.77	x	3.6	x	9.21	x	0.63	x	0.7	=	10.14	(81)
Northwest 0.9x	0.77	x	2.86	x	9.21	x	0.63	x	0.7	=	8.05	(81)
Northwest 0.9x	0.77	x	0.5	x	9.21	x	0.63	x	0.7	=	1.41	(81)
Northwest 0.9x	0.77	x	0.7	x	9.21	x	0.63	x	0.7	=	1.97	(81)
Northwest 0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	7.1	(81)
Northwest 0.9x	0.77	x	1.44	x	9.21	x	0.63	x	0.7	=	8.11	(81)
Rooflights 0.9x	1	x	6.3	x	26	x	0.63	x	0.7	=	65.01	(82)
Rooflights 0.9x	1	x	12.26	x	26	x	0.63	x	0.7	=	126.52	(82)
Rooflights 0.9x	1	x	6.27	x	26	x	0.63	x	0.7	=	64.7	(82)
Rooflights 0.9x	1	x	7.84	x	26	x	0.63	x	0.7	=	80.9	(82)
Rooflights 0.9x	1	x	3.96	x	26	x	0.63	x	0.7	=	40.86	(82)
Rooflights 0.9x	1	x	0.64	x	39.98	x	0.63	x	0.7	=	10.15	(82)
Rooflights 0.9x	1	x	6.3	x	54	x	0.63	x	0.7	=	135.03	(82)
Rooflights 0.9x	1	x	12.26	x	54	x	0.63	x	0.7	=	262.76	(82)
Rooflights 0.9x	1	x	6.27	x	54	x	0.63	x	0.7	=	134.38	(82)
Rooflights 0.9x	1	x	7.84	x	54	x	0.63	x	0.7	=	168.03	(82)
Rooflights 0.9x	1	x	3.96	x	54	x	0.63	x	0.7	=	84.87	(82)
Rooflights 0.9x	1	x	0.64	x	73.48	x	0.63	x	0.7	=	18.67	(82)
Rooflights 0.9x	1	x	6.3	x	96	x	0.63	x	0.7	=	240.05	(82)
Rooflights 0.9x	1	x	12.26	x	96	x	0.63	x	0.7	=	467.14	(82)
Rooflights 0.9x	1	x	6.27	x	96	x	0.63	x	0.7	=	238.9	(82)
Rooflights 0.9x	1	x	7.84	x	96	x	0.63	x	0.7	=	298.72	(82)
Rooflights 0.9x	1	x	3.96	x	96	x	0.63	x	0.7	=	150.89	(82)
Rooflights 0.9x	1	x	0.64	x	112.11	x	0.63	x	0.7	=	28.48	(82)
Rooflights 0.9x	1	x	6.3	x	150	x	0.63	x	0.7	=	375.07	(82)
Rooflights 0.9x	1	x	12.26	x	150	x	0.63	x	0.7	=	729.9	(82)
Rooflights 0.9x	1	x	6.27	x	150	x	0.63	x	0.7	=	373.28	(82)
Rooflights 0.9x	1	x	7.84	x	150	x	0.63	x	0.7	=	466.75	(82)
Rooflights 0.9x	1	x	3.96	x	150	x	0.63	x	0.7	=	235.76	(82)
Rooflights 0.9x	1	x	0.64	x	153.81	x	0.63	x	0.7	=	39.07	(82)
Rooflights 0.9x	1	x	6.3	x	192	x	0.63	x	0.7	=	480.09	(82)
Rooflights 0.9x	1	x	12.26	x	192	x	0.63	x	0.7	=	934.27	(82)
Rooflights 0.9x	1	x	6.27	x	192	x	0.63	x	0.7	=	477.8	(82)
Rooflights 0.9x	1	x	7.84	x	192	x	0.63	x	0.7	=	597.45	(82)
Rooflights 0.9x	1	x	3.96	x	192	x	0.63	x	0.7	=	301.77	(82)
Rooflights 0.9x	1	x	0.64	x	182.63	x	0.63	x	0.7	=	46.39	(82)
Rooflights 0.9x	1	x	6.3	x	200	x	0.63	x	0.7	=	500.09	(82)

Rooflights 0.9x	1	x	12.26	x	200	x	0.63	x	0.7	=	973.2	(82)
Rooflights 0.9x	1	x	6.27	x	200	x	0.63	x	0.7	=	497.71	(82)
Rooflights 0.9x	1	x	7.84	x	200	x	0.63	x	0.7	=	622.34	(82)
Rooflights 0.9x	1	x	3.96	x	200	x	0.63	x	0.7	=	314.34	(82)
Rooflights 0.9x	1	x	0.64	x	184.99	x	0.63	x	0.7	=	46.99	(82)
Rooflights 0.9x	1	x	6.3	x	189	x	0.63	x	0.7	=	472.59	(82)
Rooflights 0.9x	1	x	12.26	x	189	x	0.63	x	0.7	=	919.67	(82)
Rooflights 0.9x	1	x	6.27	x	189	x	0.63	x	0.7	=	470.34	(82)
Rooflights 0.9x	1	x	7.84	x	189	x	0.63	x	0.7	=	588.11	(82)
Rooflights 0.9x	1	x	3.96	x	189	x	0.63	x	0.7	=	297.06	(82)
Rooflights 0.9x	1	x	0.64	x	176.88	x	0.63	x	0.7	=	44.93	(82)
Rooflights 0.9x	1	x	6.3	x	157	x	0.63	x	0.7	=	392.57	(82)
Rooflights 0.9x	1	x	12.26	x	157	x	0.63	x	0.7	=	763.96	(82)
Rooflights 0.9x	1	x	6.27	x	157	x	0.63	x	0.7	=	390.7	(82)
Rooflights 0.9x	1	x	7.84	x	157	x	0.63	x	0.7	=	488.54	(82)
Rooflights 0.9x	1	x	3.96	x	157	x	0.63	x	0.7	=	246.76	(82)
Rooflights 0.9x	1	x	0.64	x	155.4	x	0.63	x	0.7	=	39.47	(82)
Rooflights 0.9x	1	x	6.3	x	115	x	0.63	x	0.7	=	287.55	(82)
Rooflights 0.9x	1	x	12.26	x	115	x	0.63	x	0.7	=	559.59	(82)
Rooflights 0.9x	1	x	6.27	x	115	x	0.63	x	0.7	=	286.18	(82)
Rooflights 0.9x	1	x	7.84	x	115	x	0.63	x	0.7	=	357.85	(82)
Rooflights 0.9x	1	x	3.96	x	115	x	0.63	x	0.7	=	180.75	(82)
Rooflights 0.9x	1	x	0.64	x	126.86	x	0.63	x	0.7	=	32.22	(82)
Rooflights 0.9x	1	x	6.3	x	66	x	0.63	x	0.7	=	165.03	(82)
Rooflights 0.9x	1	x	12.26	x	66	x	0.63	x	0.7	=	321.16	(82)
Rooflights 0.9x	1	x	6.27	x	66	x	0.63	x	0.7	=	164.25	(82)
Rooflights 0.9x	1	x	7.84	x	66	x	0.63	x	0.7	=	205.37	(82)
Rooflights 0.9x	1	x	3.96	x	66	x	0.63	x	0.7	=	103.73	(82)
Rooflights 0.9x	1	x	0.64	x	84.6	x	0.63	x	0.7	=	21.49	(82)
Rooflights 0.9x	1	x	6.3	x	33	x	0.63	x	0.7	=	82.52	(82)
Rooflights 0.9x	1	x	12.26	x	33	x	0.63	x	0.7	=	160.58	(82)
Rooflights 0.9x	1	x	6.27	x	33	x	0.63	x	0.7	=	82.12	(82)
Rooflights 0.9x	1	x	7.84	x	33	x	0.63	x	0.7	=	102.69	(82)
Rooflights 0.9x	1	x	3.96	x	33	x	0.63	x	0.7	=	51.87	(82)
Rooflights 0.9x	1	x	0.64	x	48.93	x	0.63	x	0.7	=	12.43	(82)
Rooflights 0.9x	1	x	6.3	x	21	x	0.63	x	0.7	=	52.51	(82)
Rooflights 0.9x	1	x	12.26	x	21	x	0.63	x	0.7	=	102.19	(82)
Rooflights 0.9x	1	x	6.27	x	21	x	0.63	x	0.7	=	52.26	(82)
Rooflights 0.9x	1	x	7.84	x	21	x	0.63	x	0.7	=	65.35	(82)
Rooflights 0.9x	1	x	3.96	x	21	x	0.63	x	0.7	=	33.01	(82)
Rooflights 0.9x	1	x	0.64	x	33.5	x	0.63	x	0.7	=	8.51	(82)

SAP WorkSheet: New dwelling design stage

Solar gains in watts, calculated for each month (83)m = Sum(74)m ...(82)m

(83)m=	1482.72	2746.05	4287.06	6108.89	7504.05	7723.21	7333.51	6262.49	4919.34	3183.2	1817.45	1241.32	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	3569.78	4820.39	6281.06	7975.72	9234.02	9336.4	8882.7	7829.96	6563.85	4955.17	3730.79	3268.05	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.92	0.84	0.73	0.62	0.67	0.85	0.95	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.55	19.57	19.58	19.63	19.64	19.69	19.69	19.7	19.67	19.64	19.62	19.6	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.9	0.8	0.65	0.49	0.55	0.8	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.55	19.57	19.58	19.63	19.64	19.69	19.69	19.7	19.67	19.64	19.62	19.6	(90)

fLA = Living area ÷ (4) = 0.06 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.64	19.65	19.66	19.71	19.72	19.76	19.76	19.77	19.75	19.72	19.7	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.64	19.65	19.66	19.71	19.72	19.76	19.76	19.77	19.75	19.72	19.7	19.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.9	0.81	0.66	0.49	0.56	0.8	0.94	0.98	0.99	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	3528.93	4714.12	6000.23	7198.63	7449.29	6117.06	4388.63	4395.69	5254.09	4669.64	3663.03	3237.66	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	28106.07	26770.25	23661.2	18572.22	13657.5	8434.76	5167.38	5464.33	9374.67	15531.16	21841.19	27323.53	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	18285.39	14821.72	13139.77	8188.99	4618.9	0	0	0	0	8080.97	13088.27	17919.89	

Total per year (kWh/year) = Sum(98)$_{1..12}$ = 98143.9 (98)

Space heating requirement in kWh/m²/year 90.04 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

SAP WorkSheet: New dwelling design stage

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	15356.71	12089.33	12318.06	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.55	0.61	0.56	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	8369.49	7433.63	6919.41	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	10271.01	9773.08	8604.26	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	1369.1	1740.56	0	0	0	0		

Total = Sum(104) = 3109.65 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.39 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	134.08	170.46	0	0	0	0	0	

Total = Sum(107) = 304.55 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.28 (108)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system: 0.04 (201)

Fraction of space heat from main system(s) — (202) = 1 – (201) = 0.96 (202)

Fraction of total heating from main system 1 — (204) = (202) × [1 – (203)] = 0.96 (204)

Efficiency of main space heating system 1: 468.59 (206)

Efficiency of secondary/supplementary heating system, %: 100 (208)

Cooling System Energy Efficiency Ratio: 4.32 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	18285.39	14821.72	13139.77	8188.99	4618.9	0	0	0	0	8080.97	13088.27	17919.89	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3753.9	3042.82	2697.53	1681.16	948.24	0	0	0	0	1658.98	2686.96	3678.86	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$ = 20148.44 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	694.84	563.23	499.31	311.18	175.52	0	0	0	0	307.08	497.35	680.96	

Total (kWh/year) =Sum(215)$_{1...5,10...12}$ = 3729.47 (215)

Water heating

Output from water heater (calculated above)

	390.84	346.81	369.69	338.99	337.69	309.63	304.88	324.19	320.38	351.14	361.76	384	

Efficiency of water heater: 65 (216)

(217)m=	65	65	65	65	65	65	65	65	65	65	65	65	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	601.29	533.55	568.76	521.52	519.53	476.36	469.04	498.76	492.89	540.22	556.55	590.76	

Total = Sum(219a)$_{1...12}$ = 6369.24 (219)

SAP WorkSheet: New dwelling design stage

Space cooling fuel, kWh/month.
(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	31.04	39.46	0	0	0	0	0

Total = Sum(221)$_{5...9}$ = 70.5 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		20148.44	
Space heating fuel used, secondary		3729.47	
Water heating fuel used		6369.24	
Space cooling fuel used		70.5	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		1551	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	2657.58	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	491.92	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	221.65	(247)
Space cooling	(221)	13.19	x 0.01 =	9.3	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	0	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	204.58	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			3705.02	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF) [(255) x (256)] ÷ [(4) + 45.0] =	1.37	(257)
SAP rating (Section 12)	80.87	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	10457.04	(261)
Space heating (secondary)	(215) x	0.519	=	1935.59	(263)
Water heating	(219) x	0.216	=	1375.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =			13768.39	(265)

SAP WorkSheet: New dwelling design stage

Space cooling	(221) x	0.519	=	36.59	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	804.97	(268)
Total CO2, kg/year	sum of (265)...(271) =			14609.95	(272)
CO2 emissions per m²	(272) ÷ (4) =			13.4	(273)
EI rating (section 14)				83	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x		3.07	=	61855.72	(261)
Space heating (secondary)	(215) x		3.07	=	11449.47	(263)
Energy for water heating	(219) x		1.22	=	7770.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =				81075.65	(265)
Space cooling	(221) x		3.07	=	216.43	(266)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	0	(267)
Electricity for lighting	(232) x		0	=	4761.57	(268)
'Total Primary Energy	sum of (265)...(271) =				86053.65	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =				78.95	(273)

APPENDIX (E)

BRE DOMESTIC REFURBISHMENT PRE-ASSESSMENT

ME7

5 TEMPLEWOOD AVENUE
HAMPSTEAD,
LONDON, NW3

Report for Demostrating Compliance

BREEAM Domestic Refurbishment

“Very Good”

PRE-ASSESSMENT

DW/625: January 2017

AUTHOR: Dudley Walker
ASSESSMENT ORGANISATION: ME7 Ltd
Licensed BREEAM Assessor – DW35

ME7 Ltd, Jorand House, Bebington Close, Billericay, Essex, CM12 0DT
Tel: +44(0)1277 353225 Mb: +44(0)7412 601472
Web: www.me7.eu Email: jb@me7.eu

M&E Consultants Energy Consultants

5 TEMPLEWOOD AVENUE
HAMPSTEAD,
LONDON, NW3

Report for Demostrating Compliance

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Description **Page No.**

Executive Summary

- Based on the evidence of this Assessment the proposed refurbishment to effect the 'deconversion' from the current three flats to two units of 50m^2 and 1087m^2 respectively can achieve "Very Good" status, based on the BREEAM Refurbishment Scheme Technical Manual SD5077 – 2014 – 2.0 Version.

- The proposals that have been considered satisfy all the mandatory minimum standards required and Illustrates how a score comfortably in excess of the threshold figure of 55% needed to achieve a "Very Good" rating under the BREEAM Scheme can be achieved.

- It is shown that satisfaction of all the minimum standards within the Energy, Water, Health/Wellbeing, Pollution and Materials Categories can achieve a level superior to "Very Good" and that the level attained in these sections relates to either an "Excellent" or "Outstanding" rating under the Scheme.

- This Pre-Assessment is based on early design information and is intended to provide guidance upon which the Design Team may rely in order to achieve Certification at Design and Post Construction Stage subject to verification by the BRE following accepted independent documentation, calculations and reports etc.

- From the following Assessment Report, it is illustrated that the proposed alterations at 5 Templewood Avenue has the potential to be an excellent example of sustainability in residential dwellings.

The Proposals

The existing property at 5 Templewood Avenue comprises a substantial 3 storey structure containing three separate flats. It is proposed to 'deconvert' the current arrangement of dwellings into two units of 50m^2 and 1,087m^2 respectively, as well as forming a basement to provide leisure facilities that will include a swimming pool, cinema, gym, study etc and plant room containing the services for the development.

The purpose of this report is to demonstrate the manner that compliance under the BREEAM Refurbishment Scheme [Technical Manual SD5077 – 2014 – 2.0 Version] can be achieved providing "Very Good" status in support of a Planning Application related to the proposals.

The BREEAM Scheme is divided into seven main elements;

- Management
- Health & Wellbeing
- Energy
- Water
- Materials
- Waste
- Pollution
-

The following sections, overleaf, demonstrate in each Category how the proposals at Templewood Avenue can achieve a "Very Good" rating under the SD5077 – 2014 – 2.0 Version of the Scheme.

BREEAM Refurbishment : Domestic Buildings – Assessment Summary

Category 1: Management

Man 01: Home User Guide

Provision of a home user guide incorporating information relating to the site and its surroundings in accordance with the 'User Guide Contents List' of the BREEAM Scheme will achieve maximum credits

3 Credits

Man 02: Responsible Construction Practices

Requires the Contractor engaged to carry out the construction work to register the site with the Considerate Constructors or equivalent scheme and achieve "Compliance" with the scheme as a minimum.

1 Credit

Man 03: Construction Site Impacts

Requires the Contractor engaged to carry out the construction work to adopt 2 procedures that monitor, report and set targets in respect of Energy use, CO_2 production, Water consumption and responsibly sourced Timber in order to achieve Credit in this Category.

1 Credit

Man 04: Security

Certified replacement external doors and accessible windows should be specified and/or adapted to meet minimum compliant security standards in order to satisfy first Credit requirements.

Advisory Note: Secured by Design Certification from an approved Police DOCO will be needed to provide the 2nd Credit that is available in this Category]

1 Credit

Man 05: Ecological Features

From cursory inspection only the trees on the site present any ecological features which are shown to be retained as part of the scheme that would satisfy the requirement for the protection Credit in this Category. However, it is noted that some trees are located quite close to the extended subterranean structure of the proposals which may prevent their retention in practice and as no SQE has been consulted at this stage to provide any perspective on this matter no Credits have been allocated.

0 Credits

Man 06: Project Management

Given the complexity of the proposals it will be of necessity that ***Project Roles &Responsibilities*** will need to be carefully addressed and ***Handover & Aftercare*** will similarly need careful attention.

2 Credits

Category 2: Health and Wellbeing

Hea 01: Daylighting

An Assessment will be required to substantiate Credit claims in this Category in due course, therefore, no assumptions are made now other than the probability that the proposals result, at least, in a neutral impact on the daylight levels in the dwellings.

1 Credit

Hea 02: Sound Insulation

It is assumed that insulation values between the two dwellings can be improved by at least 3dB's compared to AD E of the Building Regulations which will need to be confirmed by Pre Completion testing by a UKAS approved testing body.

3 Credits

Hea 03: Volatile Organic Compounds

It is assumed that in providing a healthy internal environment that fittings and finishes with low VOC's will be specified and used.

1 Credit

Hea 04: Inclusive Design

It is unclear at this stage whether minimum accessibility compliant with Section 1 of Checklist A-8 of the BEEAM Technical Guide can be achieved, therefore, for the purposes of this assessment no Credits have been assumed.

0 Credits

Hea 05: Ventilation

The project will be the subject of Building Regulations approval and will be required to satisfy AD F 2010 as a minimum related to background trickle ventilation but given the complexity of the services involved with the project it is assumed that ventilation to the dwellings will be provided that meets Section 5 of the B Regs Part F in full.

[Advisory Note: Mandatory requirement that achieves BREEAM "Outstanding" status]

2 Credits

Hea 06: Safety

The proposals include a compliant fire detection system being provided and that the system will to be wired in to the dwelling's main electricity supply.

[Advisory Note: Mandatory requirement that achieves BREEAM 'Outstanding' status]

1 Credit

Category 3: Energy

Ene 01: Energy Efficiency Improvement	Preliminary Design Stage SAP Assessments that have considered the nature of the fabric, windows, insulation etc of the construction, pre & post refurbishment of the dwelling reveal that the Energy Efficiency rating can be improved by a minimum of 19. **2 Credits**
Ene 02: Post Refurbishment Energy Efficiency	Preliminary Design Stage SAP Assessments that have considered the nature of the fabric, windows, insulation etc of the proposed construction reveal that the energy efficiency rating post refurbishment can be improved to a minimum of 70. **[Advisory Note: Mandatory requirement that achieves BREEAM 'Excellent' status]** **2.5 Credits**
Ene 03: Primary Energy Demand	Preliminary Design Stage SAP Assessments that have considered the nature of the fabric, windows, insulation etc of the proposed construction and the heating regime reveal a primary energy demand of ≤320kWh/m2/year. **2 Credits**
Ene 04: Renewable Technologies	LZC Technologies will be installed as part of the energy solution that will comply with the London Plan and provide at least 20% of each dwellings Primary Energy Demand per annum. **2 Credits**
Ene 05: White Goods	A+ Fridge/Freezers and A rated Washing Machines and Dishwashers are to be supplied that are recognised by the Energy Saving Trust. **2 Credits**
Ene 06: Drying Space	External secure drying facilities comprising a min line length 4m+ for the 1 Bed Flat and min 6m+ for the main dwelling are to be provided that comply with the Scheme. **1 Credit**
Ene 07: Lighting	Low energy Space & Security fittings are to be provided throughout that also results in a max average of 9 watts/m2 across the total floor area of the dwelling. **2 Credits**
Ene 08: Energy Display Devices	Smart meters are to be installed registering the use of electricity and primary heating fuel allied to an EDD allowing monitoring of consumption **2 Credits** That is also capable of recording consumption data for the dwelling occupants. **1 Credit**

Ene 09: Cycle Storage	Insufficient space for the storage of cycles for the main dwelling disallows Credit allocation in this Category at this stage. [Advisory Note: To achieve 1 Credit 3 spaces are required and 2 Credits requires 5 spaces] **0 Credits**
Ene 10: Home Office	A specific space with all necessary services that includes 2xdouble power sockets & telephone point is to be provided to allow the set up of a Home Office which will also include a window providing adequate ventilation and achieving an average daylight factor of 1.5%. **1 Credit**

Category 4: Water

Wat 01: Internal Water Use

The provision of Dual flush WC's, attention to bath size and restricted flow to showers, basins and kitchen taps will ensure that water consumption can be restricted to the maximum of 105litres /person/day required by LB Camden.

[Advisory Note: Mandatory requirement that achieves BREEAM 'Excellent' status]

2.5 Credits

Wat 02: External Water Use

As part of the site drainage scheme a minimum 200 litre harvesting tank is proposed to collect rainwater for the purpose of external irrigation.

1 Credit

Wat 03: Water Meter

It is part of the mechanical installation that a water meter will be included within the service proposals for the development that will allow dwelling occupants to readily monitor potable water consumption.

1 Credit

Category 5: Materials

Mat 01: Environmental Impact of Materials

BRE Green Guide ratings related to the roof, external walls, internal walls, upper & ground floors and windows are conservatively assessed as achieving a minimum 12 Credits of the 25 available.

12 Credits

Mat 02: Responsible Sourcing of Materials

6 of the 12 Credits available have been assumed at this Assessment Stage related to responsible sourcing of basic &/or finishing materials. It will be a matter of contractual responsibility that all new timber will be sourced in accordance with the UK Government's Timber Procurement Policy in that all new timber is to be purchased through independent verifiable legal and sustainable sources or FLEGT licensed or equivalent sources.

[Advisory Note: Mandatory requirement that achieves BREEAM 'Outstanding' status]

6 Credits

Mat 03: Insulation

No Credits have been assumed at this Assessment Stage related to embodied environmental impact of any new insulation introduced into the construction as the requirement for new insulation has not been determined. However, in recognition of the Energy Efficiency Rating Post Refurbishment discussed under Ene 02, Credits are achieved under Responsible Sourcing by default.

4 Credits

Category 6: Waste

Was 01:Household Waste

Dedicated internal storage provided with minimum 30 litre capacity located in the kitchens together with external space provided for waste bins and Local Authority providing weekly collections for waste and recyclables will comply.

1 Credit

Provision of composting facility – kitchen & green waste – either through LA collection scheme and/or private facility

1 Credit

Was 02: Site Waste Management

It is assumed that contractual arrangements will require a compliant Site Waste Management be in place that will include, at the least, Good Practice Waste Benchmarks.

2 Credits

Category 7: Pollution

Pol 01: Nox Emissions

It is assumed that primary space and hot water heating will be provided by a boiler superior to Class 5 providing dry NOx emissions $\leq$ 40mg/kWh.

3 Credit

Pol 02: Surface Water Run-Off

It is assumed that the surface water treatment for the site will provide, at the very least, a neutral impact on discharge from the site.

1 Credit

Pol 03: Flooding

Consultation of the available Environmental Agency data indicates the site to be located in an area of low risk that, in due course, a suitably qualified professional will be required to substantiate within a compliant Flood Risk Analysis.

[Advisory Note: Mandatory requirement that achieves BREEAM 'Outstanding' status]

2 Credits

Appraisal:

Compilation of the above attributable Credits through the BREEAM Calculator Tool reveals an overall score for the proposals of 65.99% comfortably superceding the 55% threshold figure required to achieve a "Very Good" rating.

The BREEAM Calculation and Summary sheet is attached overleaf as an Appendix in confirmation of the rating achieved under the Domestic Refurbishment Scheme

Dudley Walker
Licensed BREEAM Assessor – DW35
E: dw@me7.eu

APPENDIX

Assessment Calculation & Summary Sheet

Demonstrating BREEAM VERY GOOD Rating

BREEAM UK Domestic Refurbishment 2014 Pre-Assessment Estimator v0.1: Results Summary

BREEAM UK

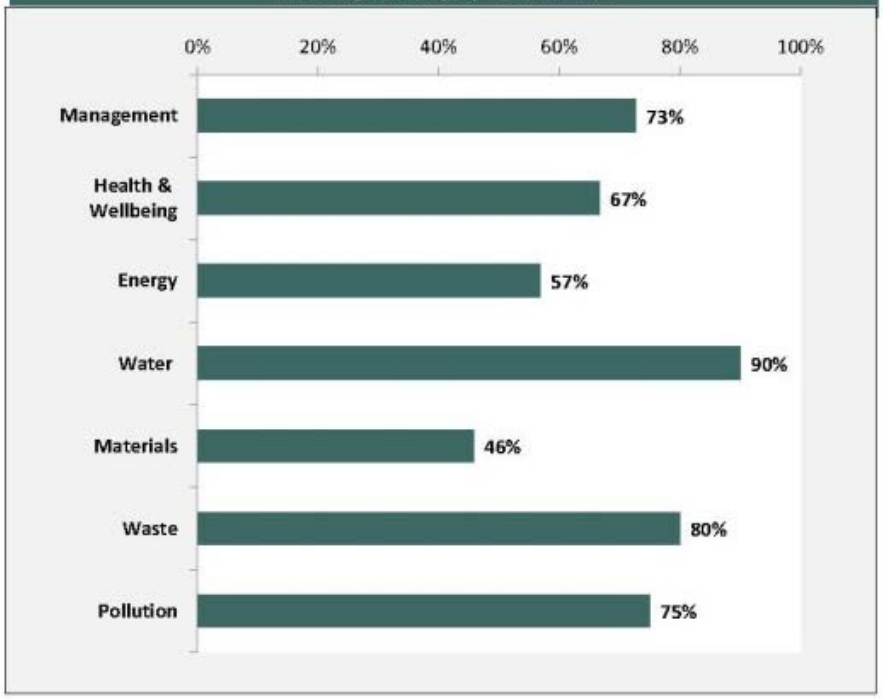
Building name	
Indicative Building Score	65.99%
Indicative Building Rating	BREEAM Very Good

This assessment and indicative BREEAM rating is not a formal certified BREEAM assessment or rating and must not be communicated as such. The score presented is indicative of a dwelling's potential performance and is based on a simplified pre-formal BREEAM assessment and unverified commitments given at an early stage in the design process.

	Issue	Credits Available	Indicative Credits Achieved	Weighting	Section Score
Management	Man 01	3	3	12%	8.73%
	Man 02	2	1		
	Man 03	1	1		
	Man 04	2	1		
	Man 05	1	0		
	Man 06	2	2		
Health and Wellbeing	Hea 01	2	1	17%	11.33%
	Hea 02	4	3		
	Hea 03	1	1		
	Hea 04	2	0		
	Hea 05	2	2		
	Hea 06	1	1		
Energy	Ene 01	6	2	43%	24.47%
	Ene 02	4	2.5		
	Ene 03	7	2		
	Ene 04	2	2		
	Ene 05	2	2		
	Ene 06	1	1		
	Ene 07	2	2		
	Ene 08	2	2		
	Ene 09	2	0		
	Ene 10	1	1		
Water	Wat 01	3	2.5	11%	9.90%
	Wat 02	1	1		
	Wat 03	1	1		
Materials	Mat 01	25	12	8%	3.67%
	Mat 02	15	6		
	Mat 03	8	4		
Waste	Was 01	2	2	3%	2.40%
	Was 02	3	2		
Pollution	Pol 01	3	3	6%	4.50%
	Pol 02	3	1		
	Pol 02	2	2		
Innovation		10	1	N/A	1.00%

	Minimum Standards				
	Pass	Good	Very Good	Excellent	Outstanding
Ene 02	✓	✓	✓	✓	✗
Wat 01	✓	✓	✓	✓	✗
Hea 05	✓	✓	✓	✓	✓
Hea 06	✓	✓	✓	✓	✓
Pol 03	✓	✓	✓	✓	✓
Mat 02	✓	✓	✓	✓	✓

Percentage of Category Score Attained



BREEAM UK Domestic Refurbishment 2014 Pre-Assessment Estimator v0.1

BREEAM UK

This assessment and indicative BREEAM rating is not a formal certified BREEAM assessment or rating and must not be communicated as such. The score presented is indicative of a dwelling's potential performance and is based on a simplified pre-formal BREEAM assessment and unverified commitments given at an early stage in the design process.

Building name	
Indicative building score (%)	65.99%
Indicative BREEAM rating	BREEAM Very Good

Management | Health & Wellbeing | Energy | Water | Material | Waste | Pollution

	Minimum Standards				
	Pass	Good	Very Good	Excellent	Outstanding
Ene 02	✓	✓	✓	✓	✗
Wat 01	✓	✓	✓	✓	✗
Hea 05	✓	✓	✓	✓	✓
Hea 06	✓	✓	✓	✓	✓
Pol 03	✓	✓	✓	✓	✓
Mat 02	✓	✓	✓	✓	✓

INNOVATION — Section Weighting: 10% — Indicative Section Score: 1.00%

Comments

MANAGEMENT — Section Weighting: 12% — Indicative Section Score: 8.73%

Man 01 Home Users Guide

No. of BREEAM credits available	3	Available contribution to overall score	3.27%
No. of BREEAM innovation credits	0	Minimum Standards applicable:	No

Assessment Criteria

Where a Home Users Guide be provided to all dwellings, covering all issues set out in the 'Users Guide Contents list', three credits may be awarded ⇨

Indicative Credits
3

Comments

Man 02 Responsible Construction Practices

No. of BREEAM credits available	2	Available contribution to overall score:	2.18%
No. of BREEAM innovation credits	1	Minimum Standards	No

Assessment Criteria

Where a compliant considerate construction scheme will be used, credits are awarded depending the score achieved as outlined below: ⇨

Indicative Credits
1

Large Scale - project with more than 5 units

	One Credit	Two Credits
Considerate Constructors Scheme	Score of 25-34 with a score of 5 in each section	Score of 35-39 with a score of 7 in each section
Alternative Compliant Scheme	Compliance	Beyond Compliance

Small Scale - project with 5 units or fewer

	One Credit	Two Credits
Considerate Constructors Scheme	Score of 25-34 with a score of 5 in each section	Score of 35-39 with a score of 7 in each section
Alternative Compliant Scheme	Compliance	Beyond Compliance
Checklist A-3	50% of the optional items	80% of the optional items

Exemplary Credit

Considerate Constructors Scheme	Score of 40 or more with a score of 7 in each section
Alternative Compliant Scheme	Exemplary Level Compliance
Checklist A-3*	All Items (Optional & Mandatory)

⇨

Indicative Innovation Credits Achieved
Please Select

* Small Scale Project Only

Comments

Man 03 Construction Site Impacts

No. of BREEAM credits available	1	Available contribution to overall score	1.09%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where evidence demonstrate that site impacts will be monitored, as detailed below: ⇨

Indicative Credits
1

	One Credit
Large Scale	Where there is evidence to demonstrate that **2 or more** of the sections in **Checklist A-4** are completed
Small Scale	Where there is evidence to demonstrate that **2 or more** of the sections in **Checklist A-5** are completed

Sections of Checklist	
Large Scale - Checklist A-4	**Small Scale - Checklist A-5**
Monitor, report and set targets for CO2 production of energy use arising from site activities	Set objectives for reducing CO2 production from energy use arising from site activities
Monitor, report and set targets for water consumption arising from site activities	Set objectives for reducing water use arising from site activities
A main contractor with an environmental materials policy	Main contractor environmental materials statement
A main contractor that operates an Environmental Management System	80% of site timber is reclaimed, re-used or responsibly sourced
80% of site timber is reclaimed, re-used or responsibly sourced	

Same definition of small and large scale as in Man 02

Comments

Man 04 Security

No. of BREEAM credits available	2	Available contribution to overall score:	2.18%
No. of BREEAM innovation credits	0	Minimum Standards applicable:	No

Assessment Criteria
Where the following requirements will be met:

		Indicative Credits
	⇨	1

One Credit Secure windows and doors	External doors and accessible windows meet minimum standards and appropriately certified
Two Credits Secured by design	Principles and guidance of Secured by Design Section 2 are complied with
	A suitably qualified security consultant is consulted at the design stage and their recommendations are incorporated into the refurbishment

Comments

Man 05 Protection and Enhancement of Ecological Features

No. of BREEAM credits available	1	Available contribution to overall score:	1.09%
No. of BREEAM innovation credits	1	Minimum Standards applicable:	No

Assessment Criteria
Where the following requirements will be met:

		Indicative Credits
	⇨	0

One Credit Protecting Ecological Features	Site survey carried out to determine presence of ecological features
	Statutory Nature Conservation Organisation notified of protected species
	Features of ecological value protected during refurbishment works

		Indicative Innovation Credits Achieved
	⇨	0

Exemplary Credit **Ecological enhancement**	A suitably qualified ecologist recommends features to enhance ecology of the site
	adopts all general ecological recommendations
	adopts 30% of additional recommendations

Comments

Man 06 Project Management

No. of BREEAM credits available	2	Available contribution to overall score	2.18%
No. of BREEAM innovation credits	2	Minimum Standards applicable	No

Assessment Criteria
Where the following requirements will be met:

		Indicative Credits
	⇨	2

One Credit Project Roles and Responsibilities	Where all of the project team are involved in the project decision making
	Small Scale - the project manager assigns individual and shared responsibilities amongst the project team including all trades on site
	Large Scale - the project manager assigns individual and shared responsibilities across the following key design and refurbishment stages: i. Planning and Building control notification ii. Design iii. Refurbishment iv. Commissioning and handover v. Occupation

Small Scale projects: five units or fewer and less than £100k

Large Scale projects: more than five units and more than £100k

One Credit Handover and Aftercare	Handover meeting arranged
	2 or more of the following committed to: - A site inspection within 3 months of occupation - Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation - Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation

		Indicative Innovation Credits Achieved
Exemplary Credits	⇨	0

One Exemplary Credit Early Design Input	Where A BREEAM Accredited Professional has been appointed to oversee key stages within the project. OR Where a BREEAM Domestic Refurbishment Assessor has been appointed at an early stage of the project, prior to the production of a refurbishment specification
One Exemplary Credit Thermographic Surveying and Airtightness Testing	Where Thermographic surveying and Airtightness testing have been carried out at both pre and post refurbishment stages Where an improved air tightness target has been set at design stage and testing demonstrates that this has been achieved post refurbishment

Comments

HEALTH & WELLBEING	Section Weighting: 17%	Indicative Section Score 11.33%

Hea 01 Daylighting

No. of BREEAM credits available	2	Available contribution to overall score	2.83%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where the refurbishment results in a neutral impact on daylighting or where minimum daylighting standards are met, up to two credits may be awarded as follows:

⇨ **Indicative Credits:** 1

For Existing Dwellings and Change of Use Projects

First Credit Maintaining Good Daylighting	The refurbishment results in a neutral impact on the dwellings daylighting levels in the kitchen, living room, dining room and study

Where the property is being extended

First Credit Maintaining Good Daylighting	New spaces achieve minimum daylighting levels
	The extension does not significantly reduce daylighting levels in the kitchen, living room, dining room or study of neighbouring properties

For All Properties

Second Credit Minimum Daylighting	The dwelling achieves minimum daylighting levels in the kitchen, living room, dining room and study

Comments

Hea 02 Sound Insulation

No. of BREEAM credits available	4	Available contribution to overall score	5.67%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

To ensure the provision of acceptable sound insulation standards and so minimise the likelihood of noise complaints.

⇨ **Indicative Credits:** 3

Properties where sound testing has been carried out:

Up to Four Credits	Four credits awarded according to the improvement over building regulations. See table in additional information in Technical Manual

Properties where sound testing is not feasible and not required by the appointed Building Control body

Two Credits	Where existing separating walls and floors are designed to meet the requirements of Building Regulations with compliant construction details
Up to Four Credits	Where a Suitably Qualified Acoustician (SQA) provides recommendations for the specification of all existing separating walls and floors
	SQA confirms in their professional opinion that they have the potential to meet or exceed the sound insulation credit requirements
	Where these recommendations are implemented
	See table in additional information in Technical Manual

Historic Buildings

Up to Four Credits	Where the dwelling is a Historic Building and sound testing results demonstrate existing separating walls and floor meet the Historic Building credit requirements
	See table in additional information in Technical Manual
	Where sound testing is not feasible and not required by the appointed Building Control body meeting criteria 2 and 3 using Table 12
	Properties where sound testing has been carried out, credits awarded according to the improvement over building regulations. See table in additional information in Technical Manual
	Where the dwelling is a detached property
	Where the dwelling is a propertywith separating walls or floors only between non habitable rooms OR Testing not required by building control body

Detached Properties

Four Credits	By Default

Properties with separating walls or floors only between non habitable rooms OR Testing not required by building control body

Four Credits	By Default

Comments

Hea 03 Volatile Organic Compounds

No. of BREEAM credits available	1	Available contribution to overall score	1.42%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where the refurbishment avoids the use of VOCs with new products meeting the following requirements:

⇨ **Indicative Credits:** 1

One Credit Avoiding the use of VOCs	Where all decorative paints and varnishes used in the refurbishment have met the requirement listed in table 5.4 in the Technical Manual
	Where at least five of the eight remaining product categories listed in table 5.4 have met the testing requirements and emission levels for Volatile Organic Compound (VOC) emissions against the relevant standards identified within table 5.4 in the Technical Manual
	Where five or less products are specified within the refurbishment, all must meet the requirements in order to achieve this credit.

Comments

Hea 04 Inclusive Design

No. of BREEAM credits available	2	Available contribution to overall score	2.83%
No. of BREEAM innovation credits	1	Minimum Standards applicable	No

Assessment Criteria

Where an access statement has been carried out using Checklist A-8 of the Technical Manual to optimise the accessibility of the home as follows:

⇨ **Indicative Credits:** 0

	Checklist A-8 of the Technical Manual	
	Section 1	Section 2
One Credit Minimum Accessibility	Completed with Evidence	
Two Credits Advanced Accessibility	Completed with Evidence	Completed with Evidence

Exemplary Performance

One Credit	Where an access expert suitably qualified member of the design team has completed sections 1, 2 and 3 of Checklist A-8, access statement template with evidence provided of the measures implemented in the refurbishment

⇨ **Indicative Innovation Credits Achieved:** 0

Comments

Hea 05 Ventilation

No. of BREEAM credits available	2	Available contribution to overall score	2.83%
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes

Assessment Criteria

Where the dwelling meets the following ventilation requirements:

⇨ **Indicative Credits:** 2

One Credit Minimum Ventilation Requirements	A minimum level of background ventilation is provided (with trickle ventilators or other means of ventilation) for all habitable rooms, kitchens, utility rooms and bathrooms compliant with section 7, Building Regulations Approved Document Part F, 2010
	A minimum level of extract ventilation is provided in all wet rooms (e.g. kitchen, utility and bath-rooms), compliant with section 5, Building Regulations Approved Document Part F 2010.
	A minimum level of purge ventilation is provided in all habitable rooms and wet rooms, compliant with section 7, Building Regulations Approved Document Part F, 2010.
	It is an historic building and meets historic building requirements in CN4 of the technical manual
Two Credits Advanced Requirements	Ventilation is provided for the dwelling that meets the requirements of Section 5 of Building Regulations Part F in full
	Where the building is a historic building and meets the requirements for Historic Buildings in compliance note 4 of the technical manual

Comments

Hea 06 Safety

No. of BREEAM credits available	1	Available contribution to overall score	1.42%
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes

Assessment Criteria

Where a fire and carbon monoxide (CO) detection and alarm system is specified as follows:

⇨ **Indicative Credits:** 1

One Credit Fire and Carbon Monoxide (CO) Detection and Alarm Systems	Where a compliant fire detection and fire alarm system is provided
	Carbon Monoxide detector installed if dwelling is supplied with mains gas or other fossil fuel
	Mains supplied fire detection and alarm system if project involves re-wiring*
	Battery operated fire detection and alarm system if no re-wiring* is to take place

*** see CN9 in Hea 06 for the definition of re-wiring**

Comments

ENERGY

Section Weighting: 43% — **Indicative Section Score 24.47%**

Ene 01 Improvement in Energy Efficiency Rating

No. of BREEAM credits available	6	Available contribution to overall score	8.90%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where the following targets are met for the improvement in Energy Efficiency Rating achieved as a result of refurbishment:

⇨ **Indicative Credits:** 2

Improvement in EER	Credits
≥ 5	0.5
≥ 9	1
≥ 13	1.5
≥ 17	2
≥ 21	2.5
≥ 26	3
≥ 31	3.5
≥ 36	4
≥ 42	4.5
≥ 48	5
≥ 54	5.5
≥ 60	6

Comments

Ene 02 Energy Efficiency Rating Post Refurbishment

No. of BREEAM credits available	4	Available contribution to overall score	5.93%
No. of BREEAM innovation credits	2	Minimum Standards applicable	Yes

Assessment Criteria

Where the following Energy Efficiency Rating benchmarks will be met as a result of refurbishment:

⇨ Indicative Credits: 2.5

EER post refurbishment	Credits	Minimum requirements
≥50	0.5	'Pass' level EER of 50
≥55	1	'Good' level EER of 58
≥60	1.5	
≥65	2	'Very Good level' EER of 65
≥70	2.5	'Excellent' level EER of 70
≥75	3	
≥80	3.5	'Outstanding' level EER of 81
≥85	4	

Exemplary	Credits
≥90	1
≥100	2

⇨ Indicative Innovation Credits Achieved: 0

Comments

Ene 03 Primary energy demand

No. of BREEAM credits available	7	Available contribution to overall score	10.38%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where the following Primary Energy Demand benchmarks will be met as a result of refurbishment:

⇨ Indicative Credits: 2

Primary Energy Demand Post Refurbishment	Credits
≤ 400	0.5
≤ 370	1
≤ 340	1.5
≤ 320	2
≤ 300	2.5
≤ 280	3
≤ 260	3.5
≤ 240	4
≤ 220	4.5
≤ 200	5
≤ 180	5.5
≤ 160	6
≤ 140	6.5
≤ 120	7

Comments

Ene 04 Renewable Technologies

No. of BREEAM credits available	2	Available contribution to overall score	2.97%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where the dwelling will meet the following % contribution from renewables and primary energy demand targets as a result of refurbishment

⇨ Indicative Credits: 2

Dwelling Type	Primary Energy Demand	Percentage from Renewables	
		1 Credit	2 Credits
Detached	≤ 250 kWh/m²/year	≥10%	≥20%
Semi-Detached		≥10%	≥20%
Bungalow		≥10%	≥20%
End of Terrace		≥10%	≥20%
Mid Terrace	≤ 220 kWh/m²/year	≥10%	≥20%
Low Rise Flat		≥10%	≥20%
Mid Rise Flat		≥10%	≥15%
High Rise Flat		≥10%	≥15%

Comments

Ene 05 Energy Labelled White Goods

No. of BREEAM credits available	2	Available contribution to overall score	2.97%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where Energy Efficiency White goods are to be provided as follows:

⇨ Indicative Credits: 2

First Credit

Appliance	Appliance provided	Appliance not to be provided
Fridges, Freezers and Fridge-Freezers	A+ Rating under EU Energy Efficiency Labelling Scheme	EU Energy Efficiency Labelling Scheme Information Leaflet provided to all dwellings

Second Credit

Appliance	Appliance provided	Appliance not to be provided
Washing Machines and Dishwashers	Washing Machine A++ under EU Energy Efficiency Labelling Scheme AND Dishwasher A+ uner EU Energy Efficiency Labelling Scheme	Second credit not achieved
Washer-Dryers and Tumble Dryers	Appliances specified with A Rating under EU Energy Efficiency Labelling Scheme	EU Energy Efficiency Labelling Scheme Information Leaflet provided to all dwellings

Comments

Ene 06 Drying Space

No. of BREEAM credits available	1	Available contribution to overall score	1.48%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where adequate, secure internal or external space with posts and footings or fixings is provided with the following:

⇨ Indicative Credits: 1

1 Credit

Number of bedrooms	Drying line required
1-2	4m+
3+	6m+

Comments

Ene 07 Lighting

No. of BREEAM credits available	2	Available contribution to overall score	2.97%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where energy efficient internal and external lighting is provided as follows:

⇨ Indicative Credits: 2

External Lighting - 1

Energy Efficient Space Lighting of more than 45 lumens per circuit watt and Energy Efficient Security Lighting OR
Where Energy Efficient Space Lighting is provided ONLY

Internal Lighting - 1

Maximum average wattage across the total floor area of the dwelling of 9 watts/m2

Comments

Ene 08 Display Energy Devices

No. of BREEAM credits available	2	Available contribution to overall score	2.97%
No. of BREEAM innovation credits	1	Minimum Standards applicable	No

Assessment Criteria

Where consumption data is displayed to occupants by a compliant energy display device

⇨ Indicative Credits: 2

Electricity usage data displayed	Primary Heating Fuel	
	Electricity	Other
Electricity usage data displayed	2 credits awarded	1 credit awarded
Primary Heating Fuel usage data displayed	N/A	1 credit awarded
Electricity & Primary Heating Fuel usage displayed	N/A	2 credits awarded

Exemplary Credits

One credit Recording consumption data	Where the first two credits are achieved
	Where any compliant Energy Display Device is capable of recording consumption data

⇨ Indicative Innovation Credits Achieved: 1

Comments

Ene 09 Cycle Storage

No. of BREEAM credits available	2	Available contribution to overall score	2.97%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where individual or communal compliant cycle storage is provided as follows:

⇨ Indicative Credits: 0

Dwelling Size	One Credit	Two Credits
Studios/ 1 bedroom	1 per two dwellings	1 per dwelling
2-3 bedrooms	1 per dwelling	2 per dwelling
4 bedrooms	2 per dwelling	4 per dwelling

Comments

Ene 10 Home Office

No. of BREEAM credits available	1	Available contribution to overall score	1.48%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where sufficient space and services will be provided to allow occupants to set up a home office in a suitable room with adequate ventilation

⇨ Indicative Credits: 1

Comments

WATER	Section Weighting: 11%	Indicative Section Score 9.90%

Wat 01 Internal Water Use

No. of BREEAM credits available	3	Available contribution to overall score	6.60%
No. of BREEAM innovation credits	1	Minimum Standards applicable	Yes

Assessment Criteria

Where the dwellings water consumption meets the following consumption benchmarks, or where terminal fittings meet the following water consumption standards:

⇨ Indicative Credits: 2.5

Calculated Water Consumption (litres/person/day)	Equivalent terminal fitting standards	Minimum Standard	Credits
>150	Typical baseline performance	N/A	0
from 140 to ≤ 150	All showers specified to 'Good' **OR** All taps and WC's to 'Good' **OR** Kitchen fittings specified to 'Excellent'	N/A	0.5
from 129 to < 140	All showers specified to 'Excellent' **OR** All showers and bathroom taps to 'Good'	BREEAM Very Good	1
from 118 to < 129	All bathroom and WC room fittings specified to 'Good' **OR** All bathroom fittings specified to 'Excellent'	N/A	1.5
from 107 to < 118	All Bathroom and WC room fittings specified to 'Excellent' **OR** All Bathroom fittings Specified to 'Excellent' and WC room fitting specified to 'Good' **OR** All Bathroom fittings, kitchen and utility sittings specified to 'Good'	BREEAM Excellent	2
from 96 to < 107	All kitchen, bathroom, utility room and WC room fittings specified to 'Good' **OR** All bathrooms, kitchens and utility rooms specified to 'Excellent'	N/A	2.5
< 96	All bathroom fittings specified to 'Excellent' and WC room, kitchen and utility room fittings specified to 'Good'	BREEAM Outstanding	3

NOTE: 'Good' fittings are equivalent to good practice fittings with "Excellent" fittings equivalent to best practice fittings (see the technical manual for full details.

Exemplary Credit	If the water consumption is less than 80l/person/day

⇨ Indicative Innovation Credits Achieved: 0

Comments

Wat 02 External Water Use

No. of BREEAM credits available	1	Available contribution to overall score	2.20%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where the following requirements will be met:

⇨ Indicative Credits: 1

Requirements:

One Credit	Where a compliant rainwater collection system for external/internal irrigation use has been provided to dwellings. **OR** Where dwellings have no individual or communal garden space.

Comments

Wat 03 Water Meter

No. of BREEAM credits available	1	Available contribution to overall score	2.20%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Where an appropriate water meter for measuring usage of mains potable water meter has been provided to dwelling(s), one credit may be awarded

⇨ Indicative Credits: 1

Comments

MATERIALS	Section Weighting: 8%	Indicative Section Score 3.67%

Mat 01 Environmental Impact of Materials

No. of BREEAM credits available	25	Available contribution to overall score	4.16%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Up to 25 credits can be awarded, with credits calculated using the Mat 01 calculator tool. The table below shows the maximum number of credits available for each element:

⇨ Indicative Credits: 12

Elements	Green Guide Rating credits available	Thermal performance credits available*
Roof	5	3
External walls	5	3.8
Internal walls (including separating walls)	5	-
Upper and Ground Floor	5	1.2
Windows	5	2

The full 25 credits represents all of the elements containing refurbished or existing materials that meet the Green Guide Rating of A+(6)

GG Rating	Points for existing / refurbished elements	Points for new elements
A+ (6)	5	
A+ (5)	4.6	
A+ (4)	4.2	
A+ (3)	3.8	
A+ (2)	3.4	
A+	3	3
A	2	2
B	1	1
C	0.5	0.5
D	0.25	0.25
E	0	0

Where the full 25 credits cannot be achieved the score can be 'topped up' with thermal performance credits. The full number of thermal performance credits for each element can be achieved when achieving the minimum U-values shown below.

Elements	Minimum U-Value

Roof	0.11
External walls	0.15
Internal walls (including separating walls)	-
Upper and Ground Floor	0.15
Windows	1.4

Comments

Mat 02 Responsible Sourcing of Materials

No. of BREEAM credits available	15	Available contribution to overall score	2.50%
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes

Assessment Criteria

Where new materials are responsibly sourced, up to 12 credits may be awarded where 80% of new materials for an element are responsibly sourced. The credits achieved are dependent on % of point achieved which is based upon the responsible sourcing tier level of each material sourced as detailed below:

Indicative Credits
6

Sustainable Procument Plan (3 BREEAM credits)
The principal contractor sources materials for the project in accordance with a documented sustainable procurement plan
OR Where the principal contractor is a Small Company (up to 3 BREEAM credits)
Checklist A-9 is filled in with supporting evidence

Will all new timber used in the project be sourced in accordance with the UK Government's Timber Procurement
Yes

Table 1

BREEAM credits	% of available points achieved
12	≥54%
10	≥45%
8	≥36%
6	≥ 27%
4	≥ 18%
2	≥ 9%

Comments

Mat 03 Insulation

No. of BREEAM credits available	8	Available contribution to overall score	1.33%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Indicative Credits
4

Where any new insulation specified for use within external walls, ground floor, roof and buildings services meet the following requirements:

Requirements	
4 Credits	Where the Insulation Index for new insulation used in the buildings is ≥2
	Where Green Guide ratings are determined using the Green Guide to specification tool

Requirements	
4 Credits	Where ≥ 80% of the new thermal insulation used in the building elements is responsibly sourced.

Comments

WASTE — Section Weighting: 3% — Indicative Section Score 2.40%

Was 01 Household Waste

No. of BREEAM credits available	2	Available contribution to overall score	1.20%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Indicative Credits
2

Where compliant recycling and composting facilities are provided, up to two credits may be awarded as follows

First Credit - Recycling Facilities	
Scenario	**Internal recycling storage requirements**
Compliant collection scheme in place	3 internal recycling containers provided where recycling is not sorted post collection
	1 internal recycling container provided where recycling is sorted post collection
	Minimum 30 litre total capacity, no single container less than 7 litre capacity
	Dedicated position in accordance with compliance note 1
No compliant collection scheme in place No adequate external storage	3 internal recycling containers provided
	Minimum 60 litre total capacity
	Dedicated position in accordance with compliance note 1
No compliant collection scheme in place Adequate external storage provided	3 internal recycling containers provided
	Minimum 30 litre total capacity, no single container smaller than 7 litre
	Dedicated position in accordance with compliance note 1

Second credit - Composting facilities	
With external space	**Without external space**
Where a composting service or facility is provided for green/garden waste	Where a composting service or facility is provided for kitchen waste
Where a composting service or facility is provided for kitchen waste	Where an interior container is provided for kitchen composting waste of at least 7 litres
Where an interior container is provided for kitchen composting waste of at least 7 litres	

Comments

Was 02 Refurbishment Site Waste Management

No. of BREEAM credits available	3	Available contribution to overall score	1.80%
No. of BREEAM innovation credits	1	Minimum Standards applicable	No

Assessment Criteria

Indicative Credits
2

Up to three credits are available depending on the site waste management plan to be implemented as follows

Projects up to £100k

Three Credits	Where waste generated through the refurbishment process is managed in accordance with Checklist A-9
Exemplary Credit	Where a compliant Level 1; Site Waste Management Plan (SWMP) is in place

Indicative Innovation Credits Achieved
0

Projects up to £300k

Three Credits	Where a compliant Level 1; Site Waste Management Plan (SWMP) is in place
	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in place
	Non-hazardous construction waste generated by the dwellings

Exemplary Credit	refurbishment meets or exceeds the resource efficiency benchmark
	The percentage of non-hazardous construction waste and demolition waste generated by the project has been diverted from landfill and meets or exceeds the refurbishment & demolition waste diversion benchmarks

Projects over £300k

First Credit Management Plan	Where a compliant Level 2; Site Waste Management Plan (SWMP) is in place
Second Credit Good Practice Waste Benchmarks	First credit achieved
	Non-hazardous construction waste generated by the dwellings refurbishment meets or exceeds the resource efficiency benchmark
	Amount of waste generated against £100,000 of project value is recorded in the SWMP
	Pre-refurbishment audit of the existing building is completed
	If demolition is included as part of the refurbishment programme, then the audit should also cover demolition materials
Third Credit Best Practice Waste Benchmarks	Where the first two credits have been achieved achieved
	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the refurbishment & demolition waste diversion benchmarks
Exemplary Credit	Where non-hazardous construction waste generated by the dwellings refurbishment meets or exceeds the *exemplary level resource efficiency benchmark*
	Where Non-hazardous demolition waste generated by the dwellings refurbishment meets or exceeds the exemplary level diversion benchmarks

Comments

POLLUTION

Section Weighting: 6%

Indicative Section Score 4.50%

Pol 01 NOx Emissions

No. of BREEAM credits available	3	Available contribution to overall score	2.25%
No. of BREEAM innovation credits	0	Minimum Standards applicable	No

Assessment Criteria

Credits are awarded on the basis of NOx emissions arising from the operation of space heating and hot water systems for each refurbished dwelling as follows:

⇨ Indicative Credits: 3

	Dry NOx Emissions
One Credit	≤100 mg/kWh (NOx class 4 boiler)
Two Credits	≤70 mg/kWh (NOx class 5 boiler)
Three Credits	≤40 mg/kWh

Comments

Pol 02 Surface Water Runoff

No. of BREEAM credits available	3	Available contribution to overall score	2.25%
No. of BREEAM innovation credits	1	Minimum Standards applicable	No

Assessment Criteria

Where impacts of the refurbishment on surface water runoff are neutralised or where runoff is reduced as a result of refurbishment, up to three credits can be awarded as follows:

⇨ Indicative Credits: 1

Requirements	
One Credit Neutral Impact on Surface Water	New hard standing areas must be permeable
	If building on to previously permeable area additional run-off must be managed on site
	Calculations should be carried out by an appropriately qualified professional

Requirements	
OR Second Credits Reducing Run-Off From Site: Basic	Where the criteria needed for One Credit has been achieved
	Where all run-off from the roof for rainfall depths up to 5 mm, have been managed on site using source control methods
	Include runoff from all existing and new parts of the roof.
	An appropriately qualified professional should be used to design an appropriate drainage strategy for the site

Requirements	
OR Three Credits Reducing Run-Off From Site: Advanced	Where run-off as a result of the refurbishment is managed on site using source control
	An appropriately qualified professional should be used to design an appropriate drainage strategy for the site.
	The peak rate of run-off as a result of the refurbishment for the 1 in 100 year event has been reduced by 75% from the existing site.
	The total volume of run-off discharged into the watercourses and sewers as a result of the refurbishment, for a 1 in 100 year event of 6 hour duration has been reduced by 75%.
	An allowance for climate change must be included for all of the above calculations, in accordance with current best practice (PPS25, 2010).

Requirements	
Exemplary Credit	Where all run-off from the developed site is managed on site using source control
	The peak rate of run-off as a result of the refurbishment for the 1 in 1 year event is reduced to zero.
	The peak rate of run-off as a result of the refurbishment for the 1 in 100 year event is reduced to zero.
	There is no volume of run-off discharged into the watercourses and sewers as a result of the refurbishment, for a 1 in 100 year event of 6 hour duration.
	An allowance for climate change must be included for all of the above calculations, in accordance with current best practice (PPS25, 2010).

⇨ Indicative Innovation Credits Achieved: 0

Comments

Pol 03 Flooding

No. of BREEAM credits available	2	Available contribution to overall score	1.50%
No. of BREEAM innovation credits	0	Minimum Standards applicable	Yes

Assessment Criteria

Where the dwelling is located in a low flood risk zone, or where in a medium to high flood risk zone and a flood resilience/resistance strategy has been implemented, up to two credits can be awarded as follows:

⇨ Indicative Credits: 2

Minimum Standards	A minimum of two credits must be achieved for this issue at the Excellent and Outstanding levels

Option 1 - Low Flood Risk

Two Credits	Where a Flood Risk Assessment (FRA) has been carried out and the assessed dwellings are defined as having a low annual probability of flooding.

Option 2 - Medium / High Flood Risk

Two Credits	Where a Flood Risk Assessment (FRA) has been carried out and the assessed dwellings are defined as having a medium or high annual probability of flooding.
	Two credits are awarded where as a result of the dwellings floor level or measures to keep water away the dwelling is defined as achieving avoidance from flooding by following Checklist A-10; Decision Strategy Flow Chart.
	Where avoidance is not possible, two credits are achieved where a full flood resilience/resistance strategy is implemented for the dwellings in accordance with recommendations made by a Suitably Qualified Building Professional

Comments