

APPENDIX F

DAMAGE AND DEFENCE COSTS ASSUMPTIONS

0.5% AEP SoP	All properties protected			All properties protected (majority of outlying properties protected through PLP or resilience)			
	Option 1: Permanent HDs only	Option 2: Permanent HDs + SCFB (>2.5m)	Option 3: Permanent HDs + Glass Walls (>2.5m)	Option 1A: Permanent HDs only	Option 2A: Permanent HDs + SCFB (>2.5m)	Option 3A: Permanent HDs + Glass Walls (>2.5m)	Option 1B: Storage & Permanent HDs
	Costs (£)			Costs (£)			
Capital costs	17,845,000	32,579,000	20,537,000	16,551,000	31,104,000	19,038,000	78,244,000
Optimism Bias Adjustment	10,892,000	19,753,000	12,527,000	10,116,000	18,867,000	11,628,000	47,507,000
Maintenance Costs (NPV over 100 years)	309,000	342,000	342,000	309,000	342,000	342,000	935,000
Total Present Value Costs	29,046,000	52,674,000	33,406,000	26,976,000	50,313,000	31,008,000	126,686,000
	Benefits (£)			Benefits (£)			
Present Value Damage	4,574,000	4,574,000	4,574,000	4,601,000	4,601,000	4,601,000	4,601,000
Present Value Damage Avoided	29,912,000	29,912,000	29,912,000	29,885,000	29,885,000	29,885,000	29,885,000
Intangible Benefit	3,243,000	3,243,000	3,243,000	3,233,000	3,233,000	3,233,000	3,233,000
Total Present Value Benefit	33,155,000	33,155,000	33,155,000	32,993,000	32,993,000	32,993,000	32,993,000
	Benefit/Cost Ratio			Benefit/Cost Ratio			
Average benefit/cost ratio	1.14	0.63	0.99	1.22	0.66	1.06	0.26

Total Cost of Option 1 (0.5% AEP SoP)	
Total Capital Cost	£15,756,640.80
Total Enabling Cost	£2,088,151.86
Total O&M Cost	£309,259.07
Total Optimism Bias	£10,892,431.03
Total Whole Life Cost	£29,046,482.76

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m.	Clearance - Vegetation killing	£230.00	1	ha	Total Capital Cost	£8,070,123.62
	0.5m cover above top of base	Clearance - Site clearance & disposal	£5.00	7,701	m2	Enabling Cost (20% of Capital Cost)	£1,614,024.72
	0.6m freeboard required	Excavation - Topsoil strip & stockpile	£3.00	7,701	m2	100 Year Operation & Maintenance Cost	£113,561.10
	0.4m wall thickness	Base Slab - Provision & placing of concrete	£200.00	3,080	m3	Optimism Bias of 60%	£5,878,625.66
	Where wall is at river bank the base starts 0.5m below river bed level	Base Slab - Reinforcement (Provision & Fix)	£1,500.00	342	t	Total Whole Life Cost	£15,676,335.11
	15% of construction cost for preliminaries	Base Slab - Trenchfill (Grade C20)	£75.00	7,701	m3		
		Base Slab - Formwork	£110.00	1,635	m2		
		Cutoff - Provision & placing of concrete	£200.00	899	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	100	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	9,241	m3		
		Cutoff - Formwork	£110.00	4,496	m2		
		Wall - Provision & placing of concrete	£200.00	3,162	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	351	t		
		Wall - Formwork (textured on one side)	£110.00	15,811	m2		
		Wall - Finish	£80.00	6,884	m2		
Flood Embankments		Drainage	£50.00	2,043	m		
	Clay core embankment	Clearance - Vegetation killing	£230.00	3	ha	Total Capital Cost	£2,370,635.68
	1 in 2.5 slope	Clearance - Site clearance & disposal	£5.00	30,683	m2	Enabling Cost (20% of Capital Cost)	£474,127.14
	15% of construction cost for preliminaries	Excavation - Topsoil strip & stockpile	£3.00	30,683	m2	100 Year Operation & Maintenance Cost	£195,697.97
	0.6m freeboard required	Filling - Provision of topsoil	£16.00	2,727	m3	Optimism Bias of 60%	£1,824,276.47
		Filling - Topsoil (300mm depth)	£8.50	2,727	m3	Total Whole Life Cost of Embankments	£4,864,737.25
		Filling - Provision of clay fill	£25.00	43,726	m3		
		Filling - Placing of clay fill	£8.50	43,726	m3		
		Geotextile mat	£3.00	31,367	m2		
		Finishing - Grassing out	£1.05	28,601	m2		
Pumping Stations		Drainage	£35.00	2,728	m		
	Costing from SEPA's Costing of Flood Risk Management Measures (F4006)						
	Category 17 - Control Structures Measures	Small pumping station	£886,000.00	6	-	Total Capital Cost inlcuding O&M	£5,315,881.50
	Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)					Optimism Bias of 60%	£3,189,528.90
						Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Option 2 (0.5% AEP SoP)	
Total Capital Cost	£28,035,419.01
Total Enabling Cost	£4,543,907.50
Total O&M Cost	£341,527.06
Total Optimism Bias	£19,752,512.15
Total Whole Life Cost	£52,673,365.72

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Self-Closing Flood Barriers (SCFB)	SCFB steel cassettes 1.5m height & 7m length	Excavation of unacceptable material Class U1A	£ 2.56	2,210	m3	Total Capital Cost	£12,680,280.20
	RC base - 0.5m thickness	Disposal of unacceptable material Class U1A	£ 19.36	2,210	m3	Enabling Cost (20% of Capital Cost)	£2,536,056.04
	15% of construction cost for preliminaries	In-situ concrete (100mm regulating layer for base	£ 220.00	123	m3	100 Year Operation & Maintenance Cost	£32,268.00
		In-situ concrete (base)	£ 250.00	614	m3	Optimism Bias of 60%	£9,149,162.54
		Form work vertical more than 300mm wide	£ 110.00	4,973	m2	Total Whole Life Cost	£24,397,766.77
		Steel fabric to BS4483 - A393	£ 15.34	1,229	m2		
		Flexcell joint filler	£ 23.23	84	m2		
		Blockwork facing	£ 123.65	3,677	m2		
		In-situ concrete (trench filled concrete)	£ 220.00	184	m3		
		SCFB steel cassettes 1.5m H 7m L	£ 80,000.00	117	-		
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m.	Clearance - Vegetation killing	£230.00	1	ha	Total Capital Cost	£7,790,547.78
	0.5m cover above top of base	Clearance - Site clearance & disposal	£5.00	7,311	m2	Enabling Cost (20% of Capital Cost)	£1,558,109.56
	0.6m freeboard required	Excavation - Topsoil strip & stockpile	£3.00	7,311	m2	100 Year Operation & Maintenance Cost	£113,561.10
	0.4m wall thickness	Base Slab - Provision & placing of concrete	£200.00	2,924	m3	Optimism Bias of 60%	£5,677,331.06
	Where wall is at river bank the base starts 0.5m below river bed level	Base Slab - Reinforcement (Provision & Fix)	£1,500.00	325	t	Total Whole Life Cost	£15,139,549.50
	15% of construction cost for preliminaries	Base Slab - Trenchfill (Grade C20)	£75.00	7,311	m3		
		Base Slab - Formwork	£110.00	1,635	m2		
		Cutoff - Provision & placing of concrete	£200.00	899	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	100	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	8,773	m3		
		Cutoff - Formwork	£110.00	4,496	m2		
		Wall - Provision & placing of concrete	£200.00	3,056	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	340	t		
		Wall - Formwork (textured on one side)	£110.00	15,281	m2		
		Wall - Finish	£80.00	6,619	m2		
		Drainage	£50.00	2,043	m		
Flood Embankments	Clay core embankment	Clearance - Vegetation killing	£230.00	371	ha	Total Capital Cost	£2,248,709.53
	1 in 2.5 slope	Clearance - Site clearance & disposal	£5.00	371	m2	Enabling Cost (20% of Capital Cost)	£449,741.91
	15% of construction cost for preliminaries	Excavation - Topsoil strip & stockpile	£3.00	32	m2	100 Year Operation & Maintenance Cost	£195,697.97
	0.6m freeboard required	Filling - Provision of topsoil	£16.00	32	m3	Optimism Bias of 60%	£1,736,489.64
		Filling - Topsoil (300mm depth)	£8.50	447	m3	Total Whole Life Cost of Embankments	£4,630,639.05
		Filling - Provision of clay fill	£25.00	447	m3		
		Filling - Placing of clay fill	£8.50	372	m3		
		Geotextile mat	£3.00	328	m2		
		Finishing - Grassing out	£1.05	44	m2		
		Drainage	£35.00	0	m		
Pumping Stations	Costing from SEPA's Costing of Flood Risk Management Measures (F4006)	Small pumping station	£886,000.00	6	-	Total Capital Cost including O&M	£5,315,881.50
	Category 17 - Control Structures Measures					Optimism Bias of 60%	£3,189,528.90
	Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)					Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Option 3 (0.5% AEP SoP)	
Total Capital Cost	£18,000,376.56
Total Enabling Cost	£2,536,899.01
Total O&M Cost	£341,533.00
Total Optimism Bias	£12,527,285.14
Total Whole Life Cost	£33,406,093.72

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Glass Walls	Glass wall, 1.5m height 2.5m length	Glass wall 1.5m H 2.5m L	£5,300.00	321	-	Total Capital Cost	£2,547,135.00
						Enabling Cost (20% of Capital Cost)	£509,427.00
						100 Year Operation & Maintenance Cost	£32,273.93
						Optimism Bias of 60%	£1,853,301.56
						Total Whole Life Cost	£4,942,137.49
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m.	Clearance - Vegetation killing	£230.00	1	ha	Total Capital Cost	£7,888,650.53
	0.5m cover above top of base	Clearance - Site clearance & disposal	£5.00	7,578	m2	Enabling Cost (20% of Capital Cost)	£1,577,730.11
	0.6m freeboard required	Excavation - Topsoil strip & stockpile	£3.00	7,578	m2	100 Year Operation & Maintenance Cost	£113,561.10
	0.4m wall thickness	Base Slab - Provision & placing of concrete	£200.00	3,031	m3	Optimism Bias of 60%	£5,747,965.04
	Where wall is at river bank the base starts 0.5m below river bed level	Base Slab - Reinforcement (Provision & Fix)	£1,500.00	337	t	Total Whole Life Cost	£15,327,906.77
	15% of construction cost for preliminaries	Base Slab - Trenchfill (Grade C20)	£75.00	7,578	m3		
		Base Slab - Formwork	£110.00	1,635	m2		
		Cutoff - Provision & placing of concrete	£200.00	899	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	100	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	9,093	m3		
		Cutoff - Formwork	£110.00	4,496	m2		
		Wall - Provision & placing of concrete	£200.00	3,056	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	340	t		
		Wall - Formwork (textured on one side)	£110.00	15,281	m2		
		Wall - Finish	£80.00	6,619	m2		
		Drainage	£50.00	2,043	m		
Flood Embankments	Clay core embankment	Clearance - Vegetation killing	£230.00	371	ha	Total Capital Cost	£2,248,709.53
	1 in 2.5 slope	Clearance - Site clearance & disposal	£5.00	371	m2	Enabling Cost (20% of Capital Cost)	£449,741.91
	15% of construction cost for preliminaries	Excavation - Topsoil strip & stockpile	£3.00	32	m2	100 Year Operation & Maintenance Cost	£195,697.97
	0.6m freeboard required	Filling - Provision of topsoil	£16.00	32	m3	Optimism Bias of 60%	£1,736,489.64
		Filling - Topsoil (300mm depth)	£8.50	447	m3	Total Whole Life Cost of Embankments	£4,630,639.05
		Filling - Provision of clay fill	£25.00	447	m3		
		Filling - Placing of clay fill	£8.50	372	m3		
		Geotextile mat	£3.00	328	m2		
		Finishing - Grassing out	£1.05	44	m2		
		Drainage	£35.00	0	m		
Pumping Stations	Costing from SEPA's Costing of Flood Risk Management Measures (F4006)	Small pumping station	£886,000.00	6	-	Total Capital Cost including O&M	£5,315,881.50
	Category 17 - Control Structures Measures					Optimism Bias of 60%	£3,189,528.90
	Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)					Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Option 1A (0.5% AEP SoP)	
Total Capital Cost	£14,777,297.20
Total Enabling Cost	£1,774,083.14
Total O&M Cost	£309,259.07
Total Optimism Bias	£10,116,383.64
Total Whole Life Cost	£26,977,023.05

Total Cost of Structural Actions	
Total Capital Cost	£14,186,297.20
Total Enabling Cost	£1,774,083.14
Total O&M Cost	£309,259.07
Total Optimism Bias	£9,761,783.64
Total Whole Life Cost	£26,031,423.05

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m. 0.5m cover above top of base 0.6m freeboard required 0.4m wall thickness Where wall is at river bank the base starts 0.5m below river bed level 15% of construction cost for preliminaries	Clearance - Vegetation killing	£230.00	1	ha	Total Capital Cost	£7,412,941.62
		Clearance - Site clearance & disposal	£5.00	7,046	m2	Enabling Cost (20% of Capital Cost)	£1,482,588.32
		Excavation - Topsoil strip & stockpile	£3.00	7,046	m2	100 Year Operation & Maintenance Cost	£113,561.10
		Base Slab - Provision & placing of concrete	£200.00	2,818	m3	Optimism Bias of 60%	£5,405,454.63
		Base Slab - Reinforcement (Provision & Fix)	£1,500.00	313	t	Total Whole Life Cost	£14,414,545.68
		Base Slab - Trenchfill (Grade C20)	£75.00	7,046	m3		
		Base Slab - Formwork	£110.00	1,451	m2		
		Cutoff - Provision & placing of concrete	£200.00	798	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	89	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	8,455	m3		
		Cutoff - Formwork	£110.00	3,990	m2		
		Wall - Provision & placing of concrete	£200.00	2,941	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	327	t		
		Wall - Formwork (textured on one side)	£110.00	14,705	m2		
		Wall - Finish	£80.00	6,446	m2		
		Drainage	£50.00	1,814	m		
Flood Embankments	Clay core embankment 1 in 2.5 slope 15% of construction cost for preliminaries 0.6m freeboard required	Clearance - Vegetation killing	£230.00	2	ha	Total Capital Cost	£1,457,474.08
		Clearance - Site clearance & disposal	£5.00	18,780	m2	Enabling Cost (20% of Capital Cost)	£291,494.82
		Excavation - Topsoil strip & stockpile	£3.00	18,780	m2	100 Year Operation & Maintenance Cost	£195,697.97
		Filling - Provision of topsoil	£16.00	1,679	m3	Optimism Bias of 60%	£1,166,800.12
		Filling - Topsoil (300mm depth)	£8.50	1,679	m3	Total Whole Life Cost of Embankments	£3,111,466.98
		Filling - Provision of clay fill	£25.00	27,120	m3		
		Filling - Placing of clay fill	£8.50	27,120	m3		
		Geotextile mat	£3.00	19,245	m2		
		Finishing - Grassing out	£1.05	17,610	m2		
		Drainage	£35.00	1,595	m		
Pumping Stations	Costing from SEPA's Costing of Flood Risk Management Measures (F4006) Category 17 - Control Structures Measures	Small pumping station	£886,000.00	6	-	Total Capital Cost including O&M	£5,315,881.50
	Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)					Optimism Bias of 60%	£3,189,528.90
						Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Non-Structural Actions		
Total Capital Cost + O&M	£	591,000.00
Total Optimism Bias	£	354,600.00
Toal Whole Life Cost	£	945,600.00

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Resistance Measures (PLP)	Data from Table 2.7 of SEPA's Costing of Flood Risk Management Measures, Category 2 - Property Resistance	Non-Residential properties with manual measures	£18,000.00	9	-	Total	£ 162,000.00
		Residential properties with manual measures	£10,500.00	4	-	Total	£ 42,000.00
Resilience Measures	Data from Table 3.6 of SEPA's Costing of Flood Risk Management Measures, Category 3 - Property Resilience	Non-Residential properties without floor replacement	£39,000.00	6	-	Total	£ 234,000.00
		Residential properties with flood replacement	£51,000.00	3	-	Total	£ 153,000.00

Total Cost of Option 2A (0.5% AEP SoP)	
Total Capital Cost	£26,904,673.88
Total Enabling Cost	£4,199,558.48
Total O&M Cost	£341,527.06
Total Optimism Bias	£18,867,455.65
Total Whole Life Cost	£50,313,215.07

Total Cost of Structural Actions	
Total Capital Cost	£26,313,673.88
Total Enabling Cost	£4,199,558.48
Total O&M Cost	£341,527.06
Total Optimism Bias	£18,512,855.65
Total Whole Life Cost	£49,367,615.07

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Self-Closing Flood Barriers (SCFB)	SCFB steel cassettes 1.5m height & 7m length RC base - 0.5m thickness 15% of construction cost for preliminaries	Excavation of unacceptable material Class U1A	£ 2.56	2,210	m3	Total Capital Cost	£12,680,280.20
		Disposal of unacceptable material Class U1A	£ 19.36	2,210	m3	Enabling Cost (20% of Capital Cost)	£2,536,056.04
		In-situ concrete (100mm regulating layer for base)	£ 220.00	123	m3	100 Year Operation & Maintenance Cost	£32,268.00
		In-situ concrete (base)	£ 250.00	614	m3	Optimism Bias of 60%	£9,149,162.54
		Form work vertical more than 300mm wide	£ 110.00	4,973	m2	Total Whole Life Cost	£24,397,766.77
		Steel fabric to BS4483 - A393	£ 15.34	1,229	m2		
		Flexcell joint filler	£ 23.23	84	m2		
		Blockwork facing	£ 123.65	3,677	m2		
		In-situ concrete (trench filled concrete)	£ 220.00	184	m3		
		SCFB steel cassettes 1.5m H 7m L	£ 80,000.00	117	-		
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m. 0.5m cover above top of base 0.6m freeboard required 0.4m wall thickness Where wall is at river bank the base starts 0.5m below river bed level 15% of construction cost for preliminaries	Clearance - Vegetation killing	£230.00	4	ha	Total Capital Cost	£6,981,964.25
		Clearance - Site clearance & disposal	£5.00	764	m2	Enabling Cost (20% of Capital Cost)	£1,396,392.85
		Excavation - Topsoil strip & stockpile	£3.00	458	m2	100 Year Operation & Maintenance Cost	£113,561.10
		Base Slab - Provision & placing of concrete	£200.00	12,218	m3	Optimism Bias of 60%	£5,095,150.92
		Base Slab - Reinforcement (Provision & Fix)	£1,500.00	10,181	t	Total Whole Life Cost	£13,587,069.12
		Base Slab - Trenchfill (Grade C20)	£75.00	11,454	m3		
		Base Slab - Formwork	£110.00	3,805	m2		
		Cutoff - Provision & placing of concrete	£200.00	3,805	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	3,171	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	13,745	m3		
		Cutoff - Formwork	£110.00	10,464	m2		
		Wall - Provision & placing of concrete	£200.00	20,181	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	16,817	t		
		Wall - Formwork (textured on one side)	£110.00	55,496	m2		
		Wall - Finish	£80.00	18,451	m2		
		Drainage	£50.00	2,162	m		
Flood Embankments	Clay core embankment 1 in 2.5 slope 15% of construction cost for preliminaries 0.6m freeboard required	Clearance - Vegetation killing	£230.00	2	ha	Total Capital Cost	£1,335,547.93
		Clearance - Site clearance & disposal	£5.00	17,685	m2	Enabling Cost (20% of Capital Cost)	£267,109.59
		Excavation - Topsoil strip & stockpile	£3.00	17,685	m2	100 Year Operation & Maintenance Cost	£195,697.97
		Filling - Provision of topsoil	£16.00	1,569	m3	Optimism Bias of 60%	£1,079,013.29
		Filling - Topsoil (300mm depth)	£8.50	1,569	m3	Total Whole Life Cost of Embankments	£2,877,368.77
		Filling - Provision of clay fill	£25.00	24,440	m3		
		Filling - Placing of clay fill	£8.50	24,440	m3		
		Geotextile mat	£3.00	18,066	m2		
		Finishing - Grassing out	£1.05	16,431	m2		
		Drainage	£35.00	1,595	m		
Pumping Stations	Costing from SEPA's Costing of Flood Risk Management Measures (F4006) Category 17 - Control Structures Measures Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)	Small pumping station	£886,000.00	6	-	Total Capital Cost inlcuding O&M	£5,315,881.50
						Optimism Bias of 60%	£3,189,528.90
						Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Non-Structural Actions		
Total Capital Cost + O&M	£	591,000.00
Total Optimism Bias	£	354,600.00
Toal Whole Life Cost	£	945,600.00

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Resistance Measures (PLP)	Data from Table 2.7 of SEPA's Costing of Flood Risk Management Measures, Category 2 - Property Resistance	Non-Residential properties with manual measures	£18,000.00	9	-	Total	£ 162,000.00
		Residential properties with manual measures	£10,500.00	4	-	Total	£ 42,000.00
Resilience Measures	Data from Table 3.6 of SEPA's Costing of Flood Risk Management Measures, Category 3 - Property Resilience	Non-Residential properties without floor replacement	£39,000.00	6	-	Total	£ 234,000.00
		Residential properties with flood replacement	£51,000.00	3	-	Total	£ 153,000.00

Total Cost of Option 3A (0.5% AEP SoP)	
Total Capital Cost	£16,849,493.89
Total Enabling Cost	£2,188,522.48
Total O&M Cost	£341,533.00
Total Optimism Bias	£11,627,729.62
Total Whole Life Cost	£31,007,279.00

Total Cost of Structural Actions	
Total Capital Cost	£16,258,493.89
Total Enabling Cost	£2,188,522.48
Total O&M Cost	£341,533.00
Total Optimism Bias	£11,273,129.62
Total Whole Life Cost	£30,061,679.00

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Glass Walls	Glass wall, 1.5m height 2.5m length	Glass wall 1.5m H 2.5m L	£5,300.00	321	-	Total Capital Cost	£2,547,135.00
						Enabling Cost (20% of Capital Cost)	£509,427.00
						100 Year Operation & Maintenance Cost	£32,273.93
						Optimism Bias of 60%	£1,853,301.56
						Total Whole Life Cost	£4,942,137.49
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m. 0.5m cover above top of base 0.6m freeboard required 0.4m wall thickness Where wall is at river bank the base starts 0.5m below river bed level 15% of construction cost for preliminaries	Clearance - Vegetation killing	£230.00	1	ha	Total Capital Cost	£7,059,929.46
		Clearance - Site clearance & disposal	£5.00	6,646	m2	Enabling Cost (20% of Capital Cost)	£1,411,985.89
		Excavation - Topsoil strip & stockpile	£3.00	6,646	m2	100 Year Operation & Maintenance Cost	£113,561.10
		Base Slab - Provision & placing of concrete	£200.00	2,658	m3	Optimism Bias of 60%	£5,151,285.87
		Base Slab - Reinforcement (Provision & Fix)	£1,500.00	295	t	Total Whole Life Cost	£13,736,762.33
		Base Slab - Trenchfill (Grade C20)	£75.00	6,646	m3		
		Base Slab - Formwork	£110.00	1,451	m2		
		Cutoff - Provision & placing of concrete	£200.00	798	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	89	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	7,975	m3		
		Cutoff - Formwork	£110.00	3,990	m2		
		Wall - Provision & placing of concrete	£200.00	2,781	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	309	t		
		Wall - Formwork (textured on one side)	£110.00	13,904	m2		
		Wall - Finish	£80.00	6,045	m2		
		Drainage	£50.00	1,814	m		
Flood Embankments	Clay core embankment 1 in 2.5 slope 15% of construction cost for preliminaries 0.6m freeboard required	Clearance - Vegetation killing	£230.00	2	ha	Total Capital Cost	£1,335,547.93
		Clearance - Site clearance & disposal	£5.00	17,685	m2	Enabling Cost (20% of Capital Cost)	£267,109.59
		Excavation - Topsoil strip & stockpile	£3.00	17,685	m2	100 Year Operation & Maintenance Cost	£195,697.97
		Filling - Provision of topsoil	£16.00	1,569	m3	Optimism Bias of 60%	£1,079,013.29
		Filling - Topsoil (300mm depth)	£8.50	1,569	m3	Total Whole Life Cost of Embankments	£2,877,368.77
		Filling - Provision of clay fill	£25.00	24,440	m3		
		Filling - Placing of clay fill	£8.50	24,440	m3		
		Geotextile mat	£3.00	18,066	m2		
		Finishing - Grassing out	£1.05	16,431	m2		
		Drainage	£35.00	1,595	m		
Pumping Stations	Costing from SEPA's Costing of Flood Risk Management Measures (F4006) Category 17 - Control Structures Measures Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)	Small pumping station	£886,000.00	6	-	Total Capital Cost including O&M	£5,315,881.50
						Optimism Bias of 60%	£3,189,528.90
						Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Non-Structural Actions		
Total Capital Cost + O&M	£	591,000.00
Total Optimism Bias	£	354,600.00
Toal Whole Life Cost	£	945,600.00

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Resistance Measures (PLP)	Data from Table 2.7 of SEPA's Costing of Flood Risk Management Measures, Category 2 - Property Resistance	Non-Residential properties with manual measures	£18,000.00	9	-	Total	£ 162,000.00
		Residential properties with manual measures	£10,500.00	4	-	Total	£ 42,000.00
Resilience Measures	Data from Table 3.6 of SEPA's Costing of Flood Risk Management Measures, Category 3 - Property Resilience	Non-Residential properties without floor replacement	£39,000.00	6	-	Total	£ 234,000.00
		Residential properties with flood replacement	£51,000.00	3	-	Total	£ 153,000.00

Total Cost of Option 1B (0.5% AEP SoP)		
Total Capital Cost		£66,220,748.77
Total Enabling Cost		£12,023,473.45
Total O&M Cost		£934,573.33
Total Optimism Bias		£47,507,277.33
Total Whole Life Cost		£126,686,072.88

Total Cost of Direct Defence and Pumping Station Actions		
Total Capital Cost		£16,622,211.72
Total Enabling Cost		£2,261,266.04
Total O&M Cost		£227,971.90
Total Optimism Bias		£11,466,869.79
Total Whole Life Cost		£30,578,319.45

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Flood Walls	RC 'L' shaped retaining wall with cut-off 'toe'. Total cutoff depth = 2m.	Clearance - Vegetation killing	£230.00	1	ha	Total Capital Cost	£10,445,767.67
	0.5m cover above top of base	Clearance - Site clearance & disposal	£5.00	10,619	m2	Enabling Cost (20% of Capital Cost)	£2,089,153.53
	0.6m freeboard required	Excavation - Topsoil strip & stockpile	£3.00	10,619	m2	100 Year Operation & Maintenance Cost	£32,273.93
	0.4m wall thickness	Base Slab - Provision & placing of concrete	£200.00	4,248	m3	Optimism Bias of 60%	£7,540,317.09
	Where wall is at river bank the base starts 0.5m below river bed level	Base Slab - Reinforcement (Provision & Fix)	£1,500.00	472	t	Total Whole Life Cost	£20,107,512.23
	15% of construction cost for preliminaries	Base Slab - Trenchfill (Grade C20)	£75.00	10,619	m3		
		Base Slab - Formwork	£110.00	1,385	m2		
		Cutoff - Provision & placing of concrete	£200.00	762	m3		
		Cutoff - Reinforcement (Provosion & Fix)	£1,500.00	85	t		
		Cutoff - Trenchfill (Grade C20)	£75.00	12,743	m3		
		Cutoff - Formwork	£110.00	3,808	m2		
		Wall - Provision & placing of concrete	£200.00	4,317	m3		
		Wall - Reinforcement (Provision & Fix)	£1,500.00	480	t		
		Wall - Formwork (textured on one side)	£110.00	21,585	m2		
		Wall - Finish	£80.00	9,927	m2		
		Drainage	£50.00	1,731	m		
Flood Embankments	Clay core embankment	Clearance - Vegetation killing	£230.00	2	ha	Total Capital Cost	£860,562.54
	1 in 2.5 slope	Clearance - Site clearance & disposal	£5.00	24,290	m2	Enabling Cost (20% of Capital Cost)	£172,112.51
	15% of construction cost for preliminaries	Excavation - Topsoil strip & stockpile	£3.00	24,290	m2	100 Year Operation & Maintenance Cost	£195,697.97
	0.6m freeboard required	Filling - Provision of topsoil	£16.00	2,118	m3	Optimism Bias of 60%	£737,023.81
		Filling - Topsoil (300mm depth)	£8.50	2,118	m3	Total Whole Life Cost of Embankments	£1,965,396.82
		Filling - Provision of clay fill	£25.00	32,858	m3		
		Filling - Placing of clay fill	£8.50	32,858	m3		
		Geotextile mat	£3.00	24,629	m2		
		Finishing - Grassing out	£1.05	22,140	m2		
		Drainage	£35.00	2,489	m		
Pumping Stations	Costing from SEPA's Costing of Flood Risk Management Measures (F4006)						
	Category 17 - Control Structures Measures	Small pumping station	£886,000.00	6	-	Total Capital Cost including O&M	£5,315,881.50
	Median whole life cost of a small pumping station (0.5m3/s - 1.5m3/s)					Optimism Bias of 60%	£3,189,528.90
						Total Whole Life Cost of Pumping Stations	£8,505,410.40

Total Cost of Storage Option		
Total Capital Cost of Option		£48,811,037.05
Total Enabling Cost of Option		£9,762,207.41
Total O&M Cost of Option		£706,601.43
Total Optimism Bias of Option		£35,567,907.53
Whole Life Cost of Option		£94,847,753.43

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Flood Embankments	Clay core embankment	Clearance - Vegetation killing	£230.00	23	ha	Total Capital Cost	£48,811,037.05
	1 in 3 slope	Clearance - Site clearance & disposal	£5.00	227,744	m2	Enabling Cost (20% of Capital Cost)	£9,762,207.41
	15% of construction cost for preliminaries	Excavation - Topsoil strip & stockpile	£3.00	227,744	m2	100 Year Operation & Maintenance Cost	£706,601.43
		Filling - Provision of topsoil	£16.00	22,167	m3	Optimism Bias of 60%	£35,567,907.53
		Filling - Topsoil (300mm depth)	£8.50	22,167	m3	Total Whole Life Cost of Embankments	£94,847,753.43
		Filling - Provision of clay fill	£25.00	1,160,997	m3		
		Filling - Placing of clay fill	£8.50	1,160,997	m3		
		Geotextile mat	£3.00	236,855	m2		
		Finishing - Grassing out	£1.05	197,696	m2		
		Drainage	£35.00	4,673	m		

Total Cost of Non-Structural Actions		
Total Capital Cost + O&M	£	787,500.00
Total Optimism Bias	£	472,500.00
Toal Whole Life Cost	£	1,260,000.00

Elements	Assumptions	Rates		Quantity	Unit	Costs	
Resistance Measures (PLP)	Data from Table 2.7 of SEPA's Costing of Flood Risk Management Measures, Category 2 - Property Resistance	Non-Residential properties with manual measures	£18,000.00	11	-	Total	£ 198,000.00
		Residential properties with manual measures	£10,500.00	7	-	Total	£ 73,500.00
Resilience Measures	Data from Table 3.6 of SEPA's Costing of Flood Risk Management Measures, Category 3 - Property Resilience	Non-Residential properties without floor replacement	£39,000.00	8	-	Total	£ 312,000.00
		Residential properties with flood replacement	£51,000.00	4	-	Total	£ 204,000.00