Table of Contents

1.	Introduction	1
	1.1 General	1
	1.2 PEST_HP in Brief	1
	1.3 Terminology	4
	1.4 Using PEST_HP	5
	1.4.1 Starting PEST_HP	5
	1.4.2 Termination of PEST_HP	
	1.4.3 Other PEST_HP Command Line Switches	6
	1.5 An Alternative Version of PEST_HP	6
	1.6 Parallel Run Management File	7
	1.7 Parallel Run Queue Files	7
	1.8 When Not to Use PEST_HP	
	1.9 The "PEST Whisperer"	7
	1.10 The PEST_HP Cost Estimator	8
2.	Marquardt Lambda Selection	. 12
	2.1 The Selection Algorithm	. 12
	2.2 Upper Upgrade Test Limit	. 13
	2.3 Lower Upgrade Test Limit	. 14
3.	HP Starter File	. 16
	3.1 The Role of the Starter File	. 16
	3.2 The "/i" Command Line Option	. 17
	3.3 SVD-Assist and the "/hpstart" Option	. 18
4.	Run Results File	. 19
	4.1 File Contents	. 19
	4.2 The RRFSAVE Option	. 19
	4.3 The "/f" Command Line Option	. 20
	4.4 Reading a Run Results File	. 22
5.	Model File Distribution	. 23
	5.1 General	. 23
	5.2 PEST Control File	. 24
	5.3 Implementation Details	. 26
	5.4 File Distribution and Broyden Jacobian Updating	. 28
	5.5 File Distribution and Randomized Jacobian	. 28
6.	PEST_HP-Specific Output Files	. 29
	6.1 General	. 29
	6.2 Objective Function Record File	. 29
	6.3 Parallel Run Efficiency File	. 29
	6.4 Parameter Error File	.30
7.	New and Altered Control Variables	.31
	7.1 Model Run Failure	.31
	7.1.1 LAMFORGIVE and DERFORGIVE	.31
	7.1.2 Record of Offending Parameter Sets	.31
	7.2 Handling of Overdue Model Runs	.32
	7.2.1 General	32

	7.2.2 The RUN_SLOW_FAC Variable	32
	7.2.3 The RUN_ABANDON_FAC Variable	33
	7.2.4 The WIN_MRUN_HOURS Variable	34
	7.3 Termination of PEST_HP	35
	7.3.1 General	35
	7.3.2 New Termination Criteria	36
	7.3.3 Specifying Values for Timeout Variables	36
	7.4 User-Prescribed Insensitivity	37
	7.4.1 General	37
	7.4.2 Implementing User-Prescribed Insensitivity	38
	7.5 Sensitivity Reuse	
	7.6 Suspension of Observation Re-referencing	40
	7.7 Alternative LSQR Settings	40
	7.8 High-Speed Regularisation	
	7.9 Using the Marquardt Lambda for Regularisation	43
	7.10 Marquardt Lambdas for SVDMODE Equal to 2	44
	7.10.1 Calculating Parameter Upgrades	44
	7.10.2 Marquardt Lambda Values	45
	7.11 Switching to Higher Order Derivatives	45
	7.12 BOUNDSCALE and JACUPDATE	46
	7.13 The UPTESTMIN and UPTESTLIM Variables	46
	7.14 Model Run Failure	47
	7.15 Observation Penalties	48
8.	Stopping and Re-Starting PEST_HP	50
	8.1 Resumption of Execution	50
	8.2 Stopping and Pausing	51
	8.3 Special Considerations for the "/f" Switch	51
9.	Randomized Jacobian	52
	9.1 Introduction	52
	9.2 Overview	52
	9.3 Randomized Jacobian Matrix: Theory	53
	9.3.1 Calculating the Jacobian Matrix	
	9.3.2 Localization	
	9.4 Randomized Jacobian Matrix: Practice	
	9.4.1 General	58
	9.4.2 PEST HP-Generated Parameter Increments	
	9.4.3 User-Supplied Parameter Increments	59
	9.4.4 Jacobian Matrix Retainment	60
	9.5 JCO and JCR Files	60
	9.6 Control Variables	61
	9.6.1 Reading the Control Variables	61
	9.6.2 RANDOMJAC	
	9.6.3 RANDOMSEED	62
	9.6.4 NRANDOMSTART, NRANDOMINC, NRANDOMFIN, PHIREDRANDINC	62
	9.6.5 RANDINCFAC	62
	9.6.6 RANDJACRETAIN	63

9.6.7 AUTOLOC, AUTOTHRESH and LASTLOCITN	63
9.6.8 LOCICOFILE	63
9.6.9 NUMINCSCHED	64
9.6.10 RANDSCHEDITN1 and RANDSCHEDITN2	64
9.6.11 INCJCBFILE	
9.6.12 RANDINCFAC and RANDJACRETAIN	
9.6.13 NUMITN and FRACORIGPHI	
9.7 Accommodating Other PEST_HP Functionality	65
9.7.1 Incompatibilities	
9.7.2 DERFORGIVE	
9.8 Experience to Date	
9.8.1 Autolocalization	
9.8.2 Increment Schedules	
9.8.3 Solution Method	
9.8.4 Tikhonov Regularisation	
9.8.5 Retainment of the Previous Jacobian Matrix	
9.8.6 Broyden Jacobian Updating	
9.8.7 Parameter Change Limits	
10. Jacobian Blanking and Simultaneous Increments	
10.1 General	
10.2 The JCOBLANK Utility	71
10.2.1 Simultaneous Parameter Increments	
10.2.2 Observation Weights	71
10.2.3 Simultaneous Increment Strategy	
10.2.4 Blanking Re-Visited	
10.2.5 Multiple Command Lines	
10.2.6 Prior Information	
10.2.7 Covariance Matrices	
10.3 PEST_HP and Simultaneous Parameter Increments	
10.4 PEST_HP Control Variables	75
10.4.1 Section in PEST Control File	75
10.4.2 Variables	75
10.5 Using SVD-Assist	79
11. Null Space Monte Carlo	81
12. Secondary Parameters	83
12.1 General	83
12.2 Defining Secondary Parameters	83
12.3 Number of Secondary Parameters and Equations	84
12.4 Operation of PEST_HP with Secondary Parameters	85
13. Compatibility Issues	86
13.1 General	
13.2 The PSTCLEAN Utility	
14. References	
Appendix 1: New Control Variables Illustrated	