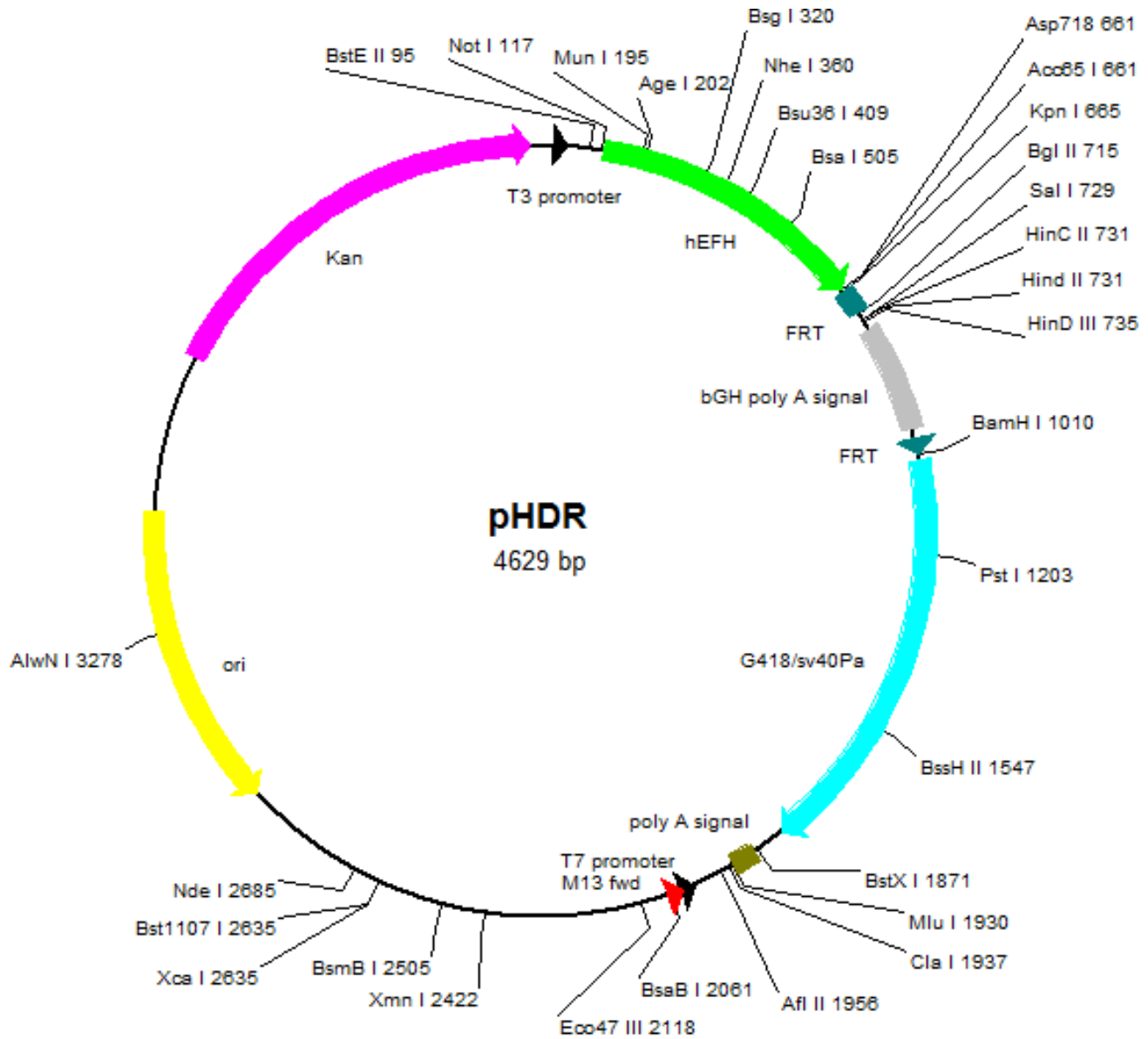


**Vector:** pHDR

**Antibiotic Selection:** Kan

**Creator(s):** Li Li & Xue Hu, Molecular Oncology Lab of The University of Chicago Medical Center

**Date of Construction:** December, 2015



## pHDR Full-Length Sequence

PmeI StuI hEFh FRT BGHpa FRT G418/SV40Pa

GGAAACAGCTATGACCATGATTACGCCAAGCTCGAAATTAACCTCACTAAAGGGAACAAAAGCTGGTACGAGGACAGGCTGGAGCCATGG  
 CTGGTGACCgtttaaacAGGCTTGGCCCGCcgctccggtgcccgtcagtgggcagagcgcacatcgccacagtcctccgagaagtgggg  
 ggaggggtcggaattgaaccggtgcctagagaaggtggcgcggggtaaactgggaaagtgatgctcgtgactggctccgccttttcccg  
 aggggtgggggagaaccgtatataagtgcagtagtcgcccgtgaacgttcttttgcgaacgggtttgcccgcagaacacagctgaagctagc  
 ttcgaggggctcgcactctctccttcacgcgcccgcgcctacctgaggccgcatccacgcgggttgagtcgcggttctgccgctcccgc  
 ctgtggtgectcctgaactgcgtccgctctaggttaagtttaagctcaggtcgagaccgggctttgtccggcgctcccttgagccta  
 cctagactcagccgctctccacgctttgctgacctgcttgcactcactccttcttctgcttttctgcttctgcccgttacagat  
 ccaagctgtgaccggcgctcaggtaccGAAGTTCCTATTCCGAAGTTCCTATTCTCTAGAAAAGTATAGGAACTCagatctTTAATTAAG  
 tcgacAAGCTTttcgaacCTCGACTGTGCCTTCTAGTTGCCAGCCATCTGTTGTTTGGCCCTCCCCGTGCCTTCTTGACCTGGAAGGT  
 GCCACTCCACTGTCTTTCTAATAAAATGAGGAAATGCATCGCATTTGCTGAGTAGGTGCATTCTATTCTGGGGGTGGGGTGGGGC  
 AGGACAGCAAGGGGAGGATTGGGAAGACAATAGCAGGCATGCTGGGGATGAAGTTCCTATTCCGAAGTTCCTATTCTCTAGAAAAGTATAG  
 GAACTTCgcatccgccaccATCATTGAACAAGATGGATTGCACGCAGGTTCTCCGGCCGCTTGGGTGGAGAGGCTATTCCGGCTATGACTGG  
 GCACAACAGACAATCGGCTGCTCTGATGCCCGCTGTTCCGGCTGTCAGCGCAGGGGCGCCCGGTTCTTTTTGTCAAGACCGACCTGTCCG  
 GTGCCCTGAATGAAGTGCAGGACGAGGCAGCGCGGCTATCGTGGCTGGCCACGACGGGCGTTCCTTGCAGCTGTGCTCGACGTTGTCAC  
 TGAAGCGGGAAGGACTGGCTGCTATTGGGCGAAGTCCCGGGCAGGATCTCTGTCTCATCTCACCTTGCCTCGCCGAGAAAAGTATCCATC  
 ATGGCTGATGCAATGCGGCGGCTGCATACGCTTATCGGCTACCTGCCATTCGACCACCAAGCGAAACATCGCATCGAGCGAGCACGTA  
 CTCGGATGGAAGCCGGTCTTGTGATCAGGATGATCTGGACGAAGAGCATCAGGGGCTCGCCAGCCGAAGTTCGCCAGGCTCAAGGC  
 GCGCATGCCCGACGGCGAGGATCTCGTCTGACCCATGGCGATGCCTGCTTCCGAATATCATGGTGGAAAATGGCCGCTTTCTGGATTC  
 ATCGACTGTGGCCGGTGGGTGTGGCGGACCCTATCAGGACATAGCGTTGGCTACCCGTGATATTGCTGAAGAGCTTGGCCGCGAATGGG  
 CTGACCGCTTCTCGTCTTACGGTATCGCCGCTCCCGATTTCGACGCGCATCGCCTTCTATCGCCTTCTTGACGAGTCTTCTGAgcggg  
 actctgggggttcgaaatgaccgaccaagcgacgcccacactgccatcacgatggcgcgaataaaatcttttattttcattacatctgtgt  
 gttggttttttgtgtgaACCGCTATCGATgtttaaacAGGCTcttaagTGCCTAATCGGACGAAAAAATGACCATGATTACGCCAAGCTC  
 CAATTCGCCCTATAGTGAGTCGTATTACAATCACTGGCCGTCGTTTTACCCGGATCTGCATCGCAGGATGCTGCTGGCTACCCTGTGGAA  
 CACCTACATCTGTATTAACGAAGCGCTGGCATTGACCCCTGAGTGATTTTTCTCTGGTCCC GCCCATCCATACC GCCAGTTGTTTACCCTC  
 ACAACGTTCCAGTAACCGGCATGTTTCATCATCAGTAACCCGATCTGTGAGCATCCTCTCTCGTTTCATCGGTATCATTACCCCATGAAC  
 AGAAATCCCCCTTACACGGAGGCATCAGTGACCAAACAGGAAAAAACCGCCCTTAACATGGCCGCTTTATCAGAAGCCAGACATTAACGC  
 TTCTGGAGAACTCAACGAGCTGGACGCGGATGAACAGGCAGACATCTGTGAATCGCTTACGACCACGCTGATGAGCTTTACCGCAGCTG  
 CCTCGCGCTTTCCGGTATGACGGTGAACCTCTGACACATGCAGCTCCCGGAGACGGTACAGCTTGTCTGTAAGCGGATGCCGGGAGC  
 AGACAAGCCCGTCAGGGCGGTCAGCGGGTGTGGCGGGTGTGGGGCGCAGCCATGACCCAGTCACGTAGCGATAGCGGAGTGTATACTG  
 GCTTAACATATGCGGCATCAGAGCAGATTGTAAGAGTGCACCATATGCGGTGTGAAATACCGCACAGATGCGTAAGGAGAAAAATACCGC  
 ATCAGGCGCTTCTCCGCTTCTCGCTCACTGACTCGCTGCGCTCGGTGTTCCGGCTGCGGCGAGCGGTATCAGCTCACTCAAAGCGGTA  
 TACGGTTATCCACAGAATCAGGGGATAACGCAGGAAAGAACAATGTGAGCAAAAAGGCCAGCAAAAAGGCCAGGAACCGTAAAAAGCCGCGTT  
 GCTGGCGTTTTTCCATAGGCTCCGCCCCCTGACGAGCATCAGAAAATCGACGCTCAAGTCAGAGGTGGCGAAAACCCGACAGGACTATAA  
 AGATAACAGGCGTTTTCCCCCTGGAAGCTCCCTCGTGCCTCTCCTGTTCCGACCCTGCCGCTTACCGGATACCTGTCCGCTTTCTCCCTT  
 CGGGAAGCGTGGCGCTTTCTCATAGCTCACGCTGTAGGTATCTCAGTTCGGTGTAGGTCTGCTCCAAGCTGGGCTGTGTGCACGAACC  
 CCCGTTACGCCGACCGCTGCGCCTTATCCGGTAACATCGTCTTGAAGTCCAAACCCGGTAAGACACGACTTATCGCCACTGGCAGCAGCC  
 ACTGGTAACAGGATTAGCAGAGCGAGGTATGTAGGCGGTGCTACAGAGTCTTGAAGTGGTGGCCTAACTACGGCTACACTAGAAGGACAG  
 TATTTGGTATCTGCGCTCTGCTGAAGCCAGTTACCTTCGAAAAAGAGTTGGTAGCTCTTGATCCGGCAAACAAACCACCCTGGTAGCGG  
 TGGTTTTTTTTGTTGCAAGCAGCAGATTACGCGCAGAAAAAAGGATCTCAAGAAGATCCTTTGATCTTTTTTACGGGGTCTGACGCTCAG  
 TGGAACGAAAACCTCACGTTAAGGATTTTGGTTCATGAGATTATCAAAAAGGATCTTACCTAGATCCTTTTTAAATAAAAATGAAGTTTTA  
 AATCAATCTAAAGTATATATGAGTAACTTGGTCTGACAGTTACCAATGCTTAATCAGTGAGGCACCTATCTCAGCGATCTGTCTATTTCCG  
 TTCATCCATAGTTGCTGACTCCCCGTCATTCAAATATGTATCCGCTCATGAGACAATAACCCCTGATAAATGCTTCAATAATATATGATTG  
 AACAGATGGATTGCACGCAGGTTCTCCGGCCGCTTGGGTGGAGAGGCTATTCGGCTATGACTGGGCACAACAGACAATCGGCTGCTCTGA  
 TGCCGCGTGTTCGGCTGTCAGCGCAGGGGCGCCCGGTTCTTTTTGTCAAGACCGACCTGTCGGTGCCTGAATGAAGTGAAGACGAG  
 GCAGCGCGGCTATCGTGGCTGGCCACGACGGGCGTTCCTTGGCAGCTGTGCTCGACGTTGCTACTGAAGCGGGAAGGGACTGGCTGCTAT  
 TGGGCGAAGTGGCGGGCAGGATCTCCTGTCTACCTTGTCTCCTGCCAGAAAAGTATCCATCATGGCTGATGCAATGGCGCGGCTGCA  
 TACGCTTGATCCGGCTACCTGCCATTTCGACCACCAAGCGAAAACATCGCATCGAGCGAGCAGTACTCGGATGGAAGCCGGTCTTGTGAT  
 CAGGATGATCTGGACGAAGAGCATCAGGGGCTCGCGCCAGCCGAAGTTCGCCAGGCTCAAGGGCAGCATGCCGACGGCGAGGATCTCG  
 TCGTGACCCATGGCGATGCTTGGCGAATATCATGGTGGAAAATGGCCGCTTTTCTGGATTATCGACTGTGGCCGGCTGGGTGTGGC  
 GGACCGCTATCAGGACATAGCGTTGGCTACCCGTGATATTGCTGAAGAGCTTGGCGCGAATGGGCTGACCGCTTCTCGTCTTACGGT  
 ATCGCCGCTCCCGATTTCGACGCGCATCGCCTTCTATCGCCTTCTTGACGAGTCTTCTGACCTTCTCGTCTTCAAGaatt

Unique enzymes in pHDR:

|                        |                |      |         |      |      |      |      |      |
|------------------------|----------------|------|---------|------|------|------|------|------|
|                        |                |      |         |      | 3447 | 3456 | 3775 | 3854 |
|                        |                |      |         |      | 3917 | 4011 | 4075 | 4176 |
| BstE II                | G`GTNAC,C      | 95   |         |      | 4179 | 4419 | 4459 | 4464 |
| Not I                  | GC`GGCC,GC     | 117  |         |      | 4514 | 4530 | 4556 |      |
| Mun I                  | C`AATT,G       | 195  | Afl II  | (1)  | 1956 |      |      |      |
| Age I                  | A`CCGG,T       | 202  | Afl III | (2)  | 1930 | 2862 |      |      |
| Bsg I                  | GTGCAG 22/20   | 320  | Age I   | (1)  | 202  |      |      |      |
| Nhe I                  | G`CTAG,C       | 360  | Aha II  | (4)  | 653  | 1150 | 1852 | 3945 |
| Bsu36 I                | CC`TNA,GG      | 409  | Ahd I   | (2)  | 3755 | 4615 |      |      |
| Bsa I                  | GGTCTC 7/11    | 505  | Alu I   | (24) | 9    | 31   | 64   | 354  |
| Acc65 I                | G`GTAC,C       | 661  |         |      | 360  | 364  | 502  | 643  |
| Asp718                 | G`GTAC,C       | 661  |         |      | 737  | 1256 | 1714 | 2000 |
| Kpn I                  | G,GTAC`C       | 665  |         |      | 2387 | 2444 | 2455 | 2504 |
| Bgl II                 | A`GATC,T       | 715  |         |      | 2523 | 2804 | 3030 | 3120 |
| Sal I                  | G`TCGA,C       | 729  |         |      | 3166 | 3423 | 4051 | 4509 |
| HinC II                | GTY RAC        | 731  | Alw I   | (15) | 631  | 1006 | 1017 | 1328 |
| Hind II                | GTY RAC        | 731  |         |      | 1395 | 1574 | 2063 | 3424 |
| HinD III               | A`AGCT,T       | 735  |         |      | 3510 | 3510 | 3607 | 3608 |
| BamH I                 | G`GATC,C       | 1010 |         |      | 4123 | 4190 | 4369 |      |
| Pst I                  | C,TGCA`G       | 1203 | AlwN I  | (1)  | 3278 |      |      |      |
| BssH II                | G`CGCG,C       | 1547 | ApaL I  | (2)  | 2678 | 3176 |      |      |
| BstX I                 | CCAN,NNNN`NTGG | 1871 | Asp718  | (1)  | 661  |      |      |      |
| Mlu I                  | A`CGCG,T       | 1930 | Ava I   | (2)  | 169  | 271  |      |      |
| Cla I                  | AT`CG,AT       | 1937 | Ava II  | (3)  | 1666 | 2149 | 4461 |      |
| Afl II                 | C`TTAA,G       | 1956 | BamH I  | (1)  | 1010 |      |      |      |
| BsaB I                 | GATNN NNATC    | 2061 | Ban I   | (11) | 130  | 205  | 461  | 652  |
| Eco47 III              | AGC GCT        | 2118 |         |      | 661  | 818  | 1149 | 1184 |
| Xmn I                  | GAANN NNTTC    | 2422 |         |      | 3703 | 3944 | 3979 |      |
| BsmB I                 | CGTCTC 7/11    | 2505 | Ban II  | (3)  | 376  | 1515 | 4310 |      |
| Bst1107 I              | GTA TAC        | 2635 | Bbe I   | (3)  | 656  | 1153 | 3948 |      |
| Xca I                  | GTA TAC        | 2635 | Bbs I   | (2)  | 942  | 4611 |      |      |
| Nde I                  | CA`TA,TG       | 2685 | Bbv I   | (12) | 1223 | 1265 | 1786 | 2464 |
| AlwN I                 | CAG,NNN`CTG    | 3278 |         |      | 2513 | 2610 | 3281 | 3284 |
| Number of enzymes = 31 |                |      |         |      | 3490 | 4018 | 4060 | 4581 |

The following enzymes do not cut in pHDR:

|         |         |           |         |        |          |      |      |                |
|---------|---------|-----------|---------|--------|----------|------|------|----------------|
| Aat II  | Apa I   | Apo I     | Asc I   | Ase I  |          |      |      |                |
| Avr II  | Bcl I   | Bgl I     | Blp I   | BseR I |          |      |      |                |
| BsiW I  | Bsm I   | Bsp120 I  | BspM II | BsrG I |          |      |      |                |
| Dra III | Eco72 I | EcoO109 I | EcoR I  | EcoR V |          |      |      |                |
| Esp I   | Fse I   | Hpa I     | Nru I   | Nsi I  | Bgl II   | (1)  | 715  |                |
| PaeR7 I | PflM I  | Pml I     | PpuM I  | PspA I | Bpm I    | (2)  | 102  | 2391           |
| Pvu I   | Sac I   | Sac II    | Sca I   | Sfi I  | Bsa I    | (1)  | 505  |                |
| Sma I   | SnaB I  | Spe I     | Spl I   | Srf I  | BsaA I   | (3)  | 1454 | 2616 4249      |
| Ssp I   | Vsp I   | Xcm I     | Xho I   | Xma I  | BsaB I   | (1)  | 2061 |                |
|         |         |           |         |        | BsaH I   | (4)  | 653  | 1150 1852 3945 |
|         |         |           |         |        | BsaJ I   | (9)  | 87   | 272 536 810    |
|         |         |           |         |        |          |      | 1313 | 1582 3022 4108 |
|         |         |           |         |        |          |      | 4377 |                |
|         |         |           |         |        | BsaW I   | (6)  | 127  | 202 1181 3068  |
|         |         |           |         |        |          |      | 3215 | 3976           |
|         |         |           |         |        | Bsg I    | (1)  | 320  |                |
|         |         |           |         |        | BsiC I   | (2)  | 742  | 1832           |
|         |         |           |         |        | BsiE I   | (5)  | 120  | 1059 2778 3202 |
|         |         |           |         |        |          |      | 3854 |                |
|         |         |           |         |        | BsiHKA I | (6)  | 1263 | 1453 2682 3180 |
|         |         |           |         |        |          |      | 4058 | 4248           |
|         |         |           |         |        | BsmA I   | (3)  | 506  | 2506 3778      |
|         |         |           |         |        | BsmB I   | (1)  | 2505 |                |
|         |         |           |         |        | BsmF I   | (5)  | 151  | 1301 1833 2135 |
|         |         |           |         |        |          |      | 4096 |                |
|         |         |           |         |        | BsoF I   | (52) | 117  | 120 123 341    |
|         |         |           |         |        |          |      | 400  | 415 446 1059   |

pHDR: sites sorted by name:

|         |      |      |                |  |  |
|---------|------|------|----------------|--|--|
| Acc I   | (2)  | 730  | 2634           |  |  |
| Acc65 I | (1)  | 661  |                |  |  |
| Aci I   | (67) | 116  | 120 123 224    |  |  |
|         |      | 261  | 341 397 400    |  |  |
|         |      | 415  | 446 453 480    |  |  |
|         |      | 1014 | 1059 1122 1216 |  |  |
|         |      | 1280 | 1381 1384 1624 |  |  |
|         |      | 1664 | 1669 1719 1735 |  |  |
|         |      | 1761 | 1817 1876 2153 |  |  |
|         |      | 2156 | 2167 2323 2339 |  |  |
|         |      | 2394 | 2450 2535 2574 |  |  |
|         |      | 2584 | 2626 2651 2689 |  |  |
|         |      | 2702 | 2728 2745 2788 |  |  |
|         |      | 2795 | 2816 2907 2935 |  |  |
|         |      | 3062 | 3081 3202 3312 |  |  |

*pHDR Vector*

|           |      |      |      |      |      |           |      |      |      |           |
|-----------|------|------|------|------|------|-----------|------|------|------|-----------|
|           |      | 1111 | 1122 | 1212 | 1217 |           | 3522 | 3600 | 3612 | 3717      |
|           |      | 1254 | 1295 | 1382 | 1385 |           | 4116 | 4194 | 4275 | 4284      |
|           |      | 1388 | 1624 | 1720 | 1761 |           | 4362 |      |      |           |
|           |      | 1775 | 1876 | 2075 | 2156 | Dra I     | (5)  | 105  | 498  | 1945 3621 |
|           |      | 2453 | 2456 | 2502 | 2599 |           | 3640 |      |      |           |
|           |      | 2652 | 2768 | 2786 | 2789 | Drd I     | (4)  | 1177 | 2557 | 2970 3972 |
|           |      | 2907 | 3062 | 3205 | 3270 | Dsa I     | (3)  | 87   | 1582 | 4377      |
|           |      | 3273 | 3479 | 3854 | 3906 | Eae I     | (11) | 117  | 1056 | 1230 1621 |
|           |      | 3917 | 4007 | 4012 | 4049 |           | 1648 | 1873 | 2039 | 3851      |
|           |      | 4090 | 4177 | 4180 | 4183 |           | 4025 | 4416 | 4443 |           |
|           |      | 4419 | 4515 | 4556 | 4570 | Eag I     | (3)  | 117  | 1056 | 3851      |
| Bsp1286 I | (2)  | 1453 | 4248 |      |      | Ear I     | (5)  | 1494 | 1704 | 2746 4289 |
| BspH I    | (2)  | 3582 | 3779 |      |      |           | 4499 |      |      |           |
| BspM I    | (5)  | 1037 | 1418 | 1868 | 3832 | Eco47 III | (1)  | 2118 |      |           |
|           |      | 4213 |      |      |      | Eco57 I   | (7)  | 375  | 697  | 1295 1727 |
| Bsr I     | (14) | 237  | 258  | 1093 | 1294 |           | 3409 | 4090 | 4522 |           |
|           |      | 2041 | 2171 | 2195 | 2610 | EcoN I    | (2)  | 213  | 408  |           |
|           |      | 2641 | 3269 | 3282 | 3396 | EcoR II   | (6)  | 810  | 1535 | 2888 3009 |
|           |      | 3888 | 4089 |      |      |           | 3022 | 4330 |      |           |
| BsrB I    | (6)  | 125  | 1763 | 1817 | 2795 | Ehe I     | (3)  | 654  | 1151 | 3946      |
|           |      | 3777 | 4558 |      |      | Fnu4H I   | (52) | 117  | 120  | 123 341   |
| BsrD I    | (2)  | 1383 | 4178 |      |      |           | 400  | 415  | 446  | 1059      |
| BssH II   | (1)  | 1547 |      |      |      |           | 1111 | 1122 | 1212 | 1217      |
| BssS I    | (3)  | 1742 | 3035 | 4537 |      |           | 1254 | 1295 | 1382 | 1385      |
| Bst1107 I | (1)  | 2635 |      |      |      |           | 1388 | 1624 | 1720 | 1761      |
| BstB I    | (2)  | 742  | 1832 |      |      |           | 1775 | 1876 | 2075 | 2156      |
| BstE II   | (1)  | 95   |      |      |      |           | 2453 | 2456 | 2502 | 2599      |
| BstN I    | (6)  | 812  | 1537 | 2890 | 3011 |           | 2652 | 2768 | 2786 | 2789      |
|           |      | 3024 | 4332 |      |      |           | 2907 | 3062 | 3205 | 3270      |
| BstU I    | (15) | 224  | 393  | 438  | 1216 |           | 3273 | 3479 | 3854 | 3906      |
|           |      | 1517 | 1549 | 1932 | 2394 |           | 3917 | 4007 | 4012 | 4049      |
|           |      | 2463 | 2465 | 2568 | 2909 |           | 4090 | 4177 | 4180 | 4183      |
|           |      | 3490 | 4011 | 4312 |      |           | 4419 | 4515 | 4556 | 4570      |
| BstX I    | (1)  | 1871 |      |      |      | Fok I     | (12) | 405  | 971  | 1474 1499 |
| BstY I    | (12) | 635  | 715  | 1010 | 1321 |           | 2083 | 2145 | 2223 | 2409      |
|           |      | 1567 | 2056 | 3503 | 3514 |           | 2550 | 3721 | 4269 | 4294      |
|           |      | 3600 | 3612 | 4116 | 4362 | Fsp I     | (2)  | 1252 | 4047 |           |
| Bsu36 I   | (1)  | 409  |      |      |      | Gdi II    | (12) | 116  | 118  | 1055 1057 |
| Cac8 I    | (36) | 114  | 362  | 376  | 397  |           | 1620 | 1647 | 1872 | 2038      |
|           |      | 560  | 588  | 770  | 947  |           | 3850 | 3852 | 4415 | 4442      |
|           |      | 951  | 1044 | 1230 | 1449 | Gsu I     | (2)  | 101  | 2390 |           |
|           |      | 1515 | 1521 | 1549 | 1553 | Hae I     | (7)  | 112  | 1232 | 1952 2877 |
|           |      | 1594 | 1598 | 1652 | 2079 |           | 2888 | 3340 | 4027 |           |
|           |      | 2121 | 2339 | 2793 | 2879 | Hae II    | (7)  | 533  | 656  | 1153 2120 |
|           |      | 2916 | 3476 | 3839 | 4025 |           | 2740 | 3110 | 3948 |           |
|           |      | 4244 | 4310 | 4316 | 4344 | Hae III   | (20) | 112  | 119  | 414 519   |
|           |      | 4348 | 4389 | 4393 | 4447 |           | 1058 | 1232 | 1623 | 1650      |
| Cfr10 I   | (8)  | 202  | 426  | 558  | 649  |           | 1875 | 1952 | 2041 | 2337      |
|           |      | 1469 | 1650 | 4264 | 4445 |           | 2877 | 2888 | 2906 | 3340      |
| Cla I     | (1)  | 1937 |      |      |      |           | 3853 | 4027 | 4418 | 4445      |
| Csp6 I    | (6)  | 68   | 252  | 662  | 1455 | Hga I     | (6)  | 466  | 1859 | 2399 2558 |
|           |      | 2669 | 4250 |      |      |           | 2972 | 3550 |      |           |
| Dde I     | (10) | 409  | 503  | 554  | 872  | HgiA I    | (6)  | 1263 | 1453 | 2682 3180 |
|           |      | 1813 | 2132 | 2672 | 3137 |           | 4058 | 4248 |      |           |
|           |      | 3546 | 3712 |      |      | HgiE II   | (3)  | 807  | 2680 | 3441      |
| Dpn I     | (21) | 637  | 717  | 1012 | 1323 | Hha I     | (31) | 152  | 224  | 395 532   |
|           |      | 1401 | 1482 | 1491 | 1569 |           | 627  | 655  | 1144 | 1152      |
|           |      | 2058 | 3430 | 3505 | 3516 |           | 1216 | 1253 | 1519 | 1549      |
|           |      | 3524 | 3602 | 3614 | 3719 |           | 1551 | 1779 | 2119 | 2465      |
|           |      | 4118 | 4196 | 4277 | 4286 |           | 2568 | 2598 | 2739 | 2772      |
|           |      | 4364 |      |      |      |           | 3042 | 3109 | 3209 | 3383      |
| DpnII     | (21) | 635  | 715  | 1010 | 1321 |           | 3492 | 3939 | 3947 | 4011      |
|           |      | 1399 | 1480 | 1489 | 1567 |           | 4048 | 4314 | 4574 |           |
|           |      | 2056 | 3428 | 3503 | 3514 | HinC II   | (1)  | 731  |      |           |

*pHDR Vector*

|          |      |      |      |      |      |           |      |      |      |      |      |
|----------|------|------|------|------|------|-----------|------|------|------|------|------|
| Hind II  | (1)  | 731  |      |      |      | 1132      | 1154 | 1182 | 1313 |      |      |
| HinD III | (1)  | 735  |      |      |      | 1403      | 1470 | 1651 | 2054 |      |      |
| Hinf I   | (13) | 433  | 552  | 1635 | 1769 | 2201      | 2508 | 2542 | 3069 |      |      |
|          |      | 1821 | 2020 | 2418 | 2762 | 3216      | 3242 | 3432 | 3850 |      |      |
|          |      | 2837 | 3233 | 3750 | 4430 | 3927      | 3949 | 3977 | 4108 |      |      |
|          |      | 4564 |      |      |      | 4198      | 4265 | 4446 |      |      |      |
| HinI I   | (4)  | 653  | 1150 | 1852 | 3945 | MspA1 I   | (7)  | 354  | 1256 | 2455 | 2574 |
| HinP I   | (31) | 150  | 222  | 393  | 530  |           |      | 3204 | 3449 | 4051 |      |
|          |      | 625  | 653  | 1142 | 1150 | Mun I     | (1)  | 195  |      |      |      |
|          |      | 1214 | 1251 | 1517 | 1547 | Nae I     | (3)  | 560  | 1652 | 4447 |      |
|          |      | 1549 | 1777 | 2117 | 2463 | Nar I     | (3)  | 653  | 1150 | 3945 |      |
|          |      | 2566 | 2596 | 2737 | 2770 | Nci I     | (10) | 516  | 1154 | 1314 | 2054 |
|          |      | 3040 | 3107 | 3207 | 3381 |           |      | 2202 | 2508 | 2543 | 3242 |
|          |      | 3490 | 3937 | 3945 | 4009 |           |      | 3949 | 4109 |      |      |
|          |      | 4046 | 4312 | 4572 |      | Nco I     | (3)  | 87   | 1582 | 4377 |      |
| Hpa II   | (31) | 128  | 203  | 427  | 515  | Nde I     | (1)  | 2685 |      |      |      |
|          |      | 527  | 559  | 650  | 1055 | NgoM I    | (3)  | 558  | 1650 | 4445 |      |
|          |      | 1132 | 1154 | 1182 | 1313 | Nhe I     | (1)  | 360  |      |      |      |
|          |      | 1403 | 1470 | 1651 | 2054 | Nla III   | (21) | 20   | 91   | 953  | 1024 |
|          |      | 2201 | 2508 | 2542 | 3069 |           |      | 1369 | 1555 | 1586 | 1612 |
|          |      | 3216 | 3242 | 3432 | 3850 |           |      | 1989 | 2209 | 2273 | 2336 |
|          |      | 3927 | 3949 | 3977 | 4108 |           |      | 2501 | 2606 | 2866 | 3586 |
|          |      | 4198 | 4265 | 4446 |      |           |      | 3783 | 4164 | 4350 | 4381 |
| Hph I    | (6)  | 106  | 1329 | 2483 | 2492 |           |      | 4407 |      |      |      |
|          |      | 3599 | 4124 |      |      | Nla IV    | (18) | 85   | 132  | 207  | 259  |
| Kas I    | (3)  | 652  | 1149 | 3944 |      |           |      | 463  | 542  | 654  | 663  |
| Kpn I    | (1)  | 665  |      |      |      |           |      | 820  | 1012 | 1151 | 1186 |
| Mae I    | (9)  | 210  | 361  | 487  | 549  |           |      | 2151 | 2894 | 2933 | 3705 |
|          |      | 695  | 762  | 990  | 3357 |           |      | 3946 | 3981 |      |      |
|          |      | 3610 |      |      |      | Not I     | (1)  | 117  |      |      |      |
| Mae II   | (9)  | 317  | 600  | 1266 | 1453 | Nsp7524 I | (6)  | 949  | 1551 | 2205 | 2497 |
|          |      | 2189 | 2615 | 3565 | 4061 |           |      | 2862 | 4346 |      |      |
|          |      | 4248 |      |      |      | NspB II   | (7)  | 354  | 1256 | 2455 | 2574 |
| Mae III  | (16) | 95   | 629  | 645  | 1270 |           |      | 3204 | 3449 | 4051 |      |
|          |      | 1576 | 2196 | 2219 | 2303 | NspH I    | (6)  | 953  | 1555 | 2209 | 2501 |
|          |      | 2516 | 2611 | 3218 | 3281 |           |      | 2866 | 4350 |      |      |
|          |      | 3397 | 3680 | 4065 | 4371 | Pal I     | (20) | 112  | 119  | 414  | 519  |
| Mbo I    | (21) | 635  | 715  | 1010 | 1321 |           |      | 1058 | 1232 | 1623 | 1650 |
|          |      | 1399 | 1480 | 1489 | 1567 |           |      | 1875 | 1952 | 2041 | 2337 |
|          |      | 2056 | 3428 | 3503 | 3514 |           |      | 2877 | 2888 | 2906 | 3340 |
|          |      | 3522 | 3600 | 3612 | 3717 |           |      | 3853 | 4027 | 4418 | 4445 |
|          |      | 4116 | 4194 | 4275 | 4284 | Ple I     | (3)  | 441  | 2028 | 3241 |      |
|          |      | 4362 |      |      |      | Pme I     | (2)  | 105  | 1945 |      |      |
| Mbo II   | (11) | 946  | 1510 | 1720 | 1802 | Psp1406 I | (2)  | 317  | 2189 |      |      |
|          |      | 2734 | 3523 | 3596 | 4305 | Pst I     | (1)  | 1203 |      |      |      |
|          |      | 4515 | 4597 | 4612 |      | Pvu II    | (4)  | 354  | 1256 | 2455 | 4051 |
| Mlu I    | (1)  | 1930 |      |      |      | Rsa I     | (6)  | 69   | 253  | 663  | 1456 |
| Mme I    | (2)  | 3076 | 3260 |      |      |           |      | 2670 | 4251 |      |      |
| Mnl I    | (31) | 53   | 65   | 178  | 267  | Rsr II    | (2)  | 1666 | 4461 |      |      |
|          |      | 362  | 404  | 458  | 474  | Sal I     | (1)  | 729  |      |      |      |
|          |      | 756  | 798  | 844  | 919  | Sap I     | (5)  | 1494 | 1704 | 2746 | 4289 |
|          |      | 1065 | 1201 | 1558 | 1750 |           |      | 4499 |      |      |      |
|          |      | 1962 | 2191 | 2249 | 2288 | Sau3A I   | (21) | 635  | 715  | 1010 | 1321 |
|          |      | 2468 | 2498 | 2760 | 2970 |           |      | 1399 | 1480 | 1489 | 1567 |
|          |      | 3043 | 3294 | 3694 | 3860 |           |      | 2056 | 3428 | 3503 | 3514 |
|          |      | 3996 | 4353 | 4545 |      |           |      | 3522 | 3600 | 3612 | 3717 |
| Msc I    | (2)  | 1232 | 4027 |      |      |           |      | 4116 | 4194 | 4275 | 4284 |
| Mse I    | (16) | 39   | 104  | 497  | 721  |           |      | 4362 |      |      |      |
|          |      | 725  | 1944 | 1957 | 2109 | Sau96 I   | (5)  | 517  | 1666 | 2149 | 2336 |
|          |      | 2329 | 2361 | 2643 | 3568 |           |      | 4461 |      |      |      |
|          |      | 3620 | 3625 | 3639 | 3692 | ScrF I    | (16) | 516  | 812  | 1154 | 1314 |
| Msl I    | (4)  | 1587 | 1869 | 1908 | 4382 |           |      | 1537 | 2054 | 2202 | 2508 |
| Msp I    | (31) | 128  | 203  | 427  | 515  |           |      | 2543 | 2890 | 3011 | 3024 |
|          |      | 527  | 559  | 650  | 1055 |           |      | 3242 | 3949 | 4109 | 4332 |

pHDR Vector

|           |      |      |      |      |      |          |                     |    |           |             |    |
|-----------|------|------|------|------|------|----------|---------------------|----|-----------|-------------|----|
| Sec I     | (9)  | 87   | 272  | 536  | 810  | BspM II  | T`CCGG,A            | -  | Bsr I     | ACT,GG`     | 14 |
|           |      | 1313 | 1582 | 3022 | 4108 | BsrB I   | GAG CGG             | 6  | BsrD I    | GCAATG, 8   | 2  |
|           |      | 4377 |      |      |      | BsrG I   | T`GTAC,A            | -  | BssH II   | G`CGCG,C    | 1  |
| SfaN I    | (24) | 386  | 868  | 1109 | 1364 | BssS I   | C`TCGT,G            | 3  | Bst1107 I | GTA TAC     | 1  |
|           |      | 1448 | 1512 | 1580 | 1787 | BstB I   | TT`CG,AA            | 2  | BstE II   | G`GTNAC,C   | 1  |
|           |      | 2062 | 2070 | 2166 | 2244 | BstN I   | CC`W,GG             | 6  | BstU I    | CG CG       | 15 |
|           |      | 2306 | 2529 | 2662 | 2700 | BstX I   | CCAN,NNNN`NTGG      | 1  | BstY I    | R`GATC,Y    | 12 |
|           |      | 2738 | 2958 | 3904 | 4159 | Bsu36 I  | CC`TNA,GG           | 1  | Cac8 I    | GCN NGC     | 36 |
|           |      | 4243 | 4307 | 4375 | 4582 | Cfr10 I  | R`CCGG,Y            | 8  | Cla I     | AT`CG,AT    | 1  |
| Sfc I     | (4)  | 1199 | 2013 | 3127 | 3318 | Csp6 I   | G`TA,C              | 6  | Dde I     | C`TNA,G     | 10 |
| Sph I     | (3)  | 953  | 1555 | 4350 |      | Dpn I    | GA TC               | 21 | DpnII     | `GATC,      | 21 |
| Stu I     | (2)  | 112  | 1952 |      |      | Dra I    | TTT AAA             | 5  | Dra III   | CAC,NNN`GTG | -  |
| Sty I     | (4)  | 87   | 536  | 1582 | 4377 | Drd I    | GACNN,NN`NNGTC      | 4  | Dsa I     | C`CRYG,G    | 3  |
| Taq I     | (19) | 33   | 367  | 509  | 730  | Eae I    | Y`GGCC,R            | 11 | Eag I     | C`GGCC,G    | 3  |
|           |      | 742  | 749  | 1263 | 1419 | Ear I    | CTCTTC 7/10         | 5  | Eco47 III | AGC GCT     | 1  |
|           |      | 1443 | 1479 | 1641 | 1832 | Eco57 I  | CTGAAG 21/19        | 7  | Eco72 I   | CAC GTG     | -  |
|           |      | 1937 | 2962 | 4058 | 4214 | EcoN I   | CCTNN`N,NNAGG       | 2  | EcoO109 I | RG`GNC,CY   | -  |
|           |      | 4238 | 4274 | 4436 |      | EcoR I   | G`AATT,C            | -  | EcoR II   | `CCWGG,     | 6  |
| Tfi I     | (6)  | 1635 | 1769 | 2418 | 2837 | EcoR V   | GAT ATC             | -  | Ehe I     | GGC GCC     | 3  |
|           |      | 4430 | 4564 |      |      | Esp I    | GC`TNA,GC           | -  | Fnu4H I   | GC`N,GC     | 52 |
| Tsp45 I   | (9)  | 95   | 645  | 1270 | 1576 | Fok I    | GGATG 14/18         | 12 | Fse I     | GG,CCGG`CC  | -  |
|           |      | 2303 | 2516 | 2611 | 4065 | Fsp I    | TGC GCA             | 2  | Gdi II    | `YGGC,CG    | 12 |
|           |      | 4371 |      |      |      | Gsu I    | CTGGAG 21/19        | 2  | Hae I     | WGG CCW     | 7  |
| Tth111 I  | (3)  | 1268 | 2609 | 4063 |      | Hae II   | R,GCGC`Y            | 7  | Hae III   | GG CC       | 20 |
| Tth111 II | (8)  | 576  | 772  | 1586 | 2324 | Hga I    | GACGC 9/14          | 6  | HgiA I    | G,WGCW`C    | 6  |
|           |      | 3451 | 3460 | 3490 | 4381 | HgiE II  | ACCNNNNNNGGT -1/133 |    | Hha I     | G,CG`C      | 31 |
| Xba I     | (2)  | 694  | 989  |      |      | Hinc II  | GTY RAC             | 1  | Hind II   | GTY RAC     | 1  |
| Xca I     | (1)  | 2635 |      |      |      | Hind III | A`AGCT,T            | 1  | Hinf I    | G`ANT,C     | 13 |
| Xho II    | (12) | 635  | 715  | 1010 | 1321 | HinI I   | GR`CG,YC            | 4  | HinP I    | G`CG,C      | 31 |
|           |      | 1567 | 2056 | 3503 | 3514 | Hpa I    | GTT AAC             | -  | Hpa II    | C`CG,G      | 31 |
|           |      | 3600 | 3612 | 4116 | 4362 | Hph I    | GGTGA 12/11         | 6  | Kas I     | G`GCGC,C    | 3  |
| Xma III   | (3)  | 117  | 1056 | 3851 |      | Kpn I    | G,GTAC`C            | 1  | Mae I     | C`TA,G      | 9  |
| Xmn I     | (1)  | 2422 |      |      |      | Mae II   | A`CG,T              | 9  | Mae III   | `GTNAC,     | 16 |
|           |      |      |      |      |      | Mbo I    | `GATC,              | 21 | Mbo II    | GAAGA 12/11 | 11 |

Site usage in pHDR:

|          |                     |    |           |                 |    |
|----------|---------------------|----|-----------|-----------------|----|
| Aat II   | G,ACGT`C            | -  | Acc I     | GT`MK,AC        | 2  |
| Acc65 I  | G`GTAC,C            | 1  | Aci I     | C`CG,C          | 67 |
| Afl II   | C`TTAA,G            | 1  | Afl III   | A`CRYG,T        | 2  |
| Age I    | A`CCGG,T            | 1  | Aha II    | GR`CG,YC        | 4  |
| Ahd I    | GACNN,N`NNGTC       | 2  | Alu I     | AG CT           | 24 |
| Alw I    | GGATC 8/9           | 15 | AlwN I    | CAG,NNN`CTG     | 1  |
| Apa I    | G,GGCC`C            | -  | ApaL I    | G`TGCA,C        | 2  |
| Apo I    | R`AATT,Y            | -  | Asc I     | GG`CGCG,CC      | -  |
| Ase I    | AT`TA,AT            | -  | Asp718    | G`GTAC,C        | 1  |
| Ava I    | C`YCGR,G            | 2  | Ava II    | G`GWC,C         | 3  |
| Avr II   | C`CTAG,G            | -  | BamH I    | G`GATC,C        | 1  |
| Ban I    | G`GYRC,C            | 11 | Ban II    | G,RCGY`C        | 3  |
| Bbe I    | G,GCGC`C            | 3  | Bbs I     | GAAGAC 8/12     | 2  |
| Bbv I    | GCAGC 13/17         | 12 | Bbv II    | GAAGAC 7/11     | 2  |
| Bcl I    | T`GATC,A            | -  | Bcn I     | CC,S`GG         | 10 |
| Bfa I    | C`TA,G              | 9  | Bgl I     | GCCN,NNN`NGGC   | -  |
| Bgl II   | A`GATC,T            | 1  | Blp I     | GC`TNA,GC       | -  |
| Bpm I    | CTGGAG 22/20        | 2  | Bsa I     | GGTCTC 7/11     | 1  |
| BsaA I   | YAC GTR             | 3  | BsaB I    | GATNN NNATC     | 1  |
| BsaH I   | GR`CG,YC            | 4  | BsaJ I    | C`CNNG,G        | 9  |
| BsaW I   | W`CCGG,W            | 6  | BseR I    | GAGGAG 16/14    | -  |
| Bsg I    | GTGCAG 22/20        | 1  | BsiC I    | TT`CG,AA        | 2  |
| BsiE I   | CG,RY`CG            | 5  | BsiHKA I  | G,WGCW`C        | 6  |
| BsiW I   | C`GTAC,G            | -  | Bsm I     | GAATG,C 7       | -  |
| BsmA I   | GTCTC`/9            | 3  | BsmB I    | CGTCTC 7/11     | 1  |
| BsmF I   | GGGAC 15/19         | 5  | BsoF I    | GC`N,GC         | 52 |
| Bsp120 I | G`GGCC,C            | -  | Bsp1286 I | G,DGCH`C        | 2  |
| BspH I   | T`CATG,A            | 2  | BspM I    | ACCTGC 10/14    | 5  |
| BspM II  | T`CCGG,A            | -  | Bsr I     | ACT,GG`         | 14 |
| BsrB I   | GAG CGG             | 6  | BsrD I    | GCAATG, 8       | 2  |
| BsrG I   | T`GTAC,A            | -  | BssH II   | G`CGCG,C        | 1  |
| BssS I   | C`TCGT,G            | 3  | Bst1107 I | GTA TAC         | 1  |
| BstB I   | TT`CG,AA            | 2  | BstE II   | G`GTNAC,C       | 1  |
| BstN I   | CC`W,GG             | 6  | BstU I    | CG CG           | 15 |
| BstX I   | CCAN,NNNN`NTGG      | 1  | BstY I    | R`GATC,Y        | 12 |
| Bsu36 I  | CC`TNA,GG           | 1  | Cac8 I    | GCN NGC         | 36 |
| Cfr10 I  | R`CCGG,Y            | 8  | Cla I     | AT`CG,AT        | 1  |
| Csp6 I   | G`TA,C              | 6  | Dde I     | C`TNA,G         | 10 |
| Dpn I    | GA TC               | 21 | DpnII     | `GATC,          | 21 |
| Dra I    | TTT AAA             | 5  | Dra III   | CAC,NNN`GTG     | -  |
| Drd I    | GACNN,NN`NNGTC      | 4  | Dsa I     | C`CRYG,G        | 3  |
| Eae I    | Y`GGCC,R            | 11 | Eag I     | C`GGCC,G        | 3  |
| Ear I    | CTCTTC 7/10         | 5  | Eco47 III | AGC GCT         | 1  |
| Eco57 I  | CTGAAG 21/19        | 7  | Eco72 I   | CAC GTG         | -  |
| EcoN I   | CCTNN`N,NNAGG       | 2  | EcoO109 I | RG`GNC,CY       | -  |
| EcoR I   | G`AATT,C            | -  | EcoR II   | `CCWGG,         | 6  |
| EcoR V   | GAT ATC             | -  | Ehe I     | GGC GCC         | 3  |
| Esp I    | GC`TNA,GC           | -  | Fnu4H I   | GC`N,GC         | 52 |
| Fok I    | GGATG 14/18         | 12 | Fse I     | GG,CCGG`CC      | -  |
| Fsp I    | TGC GCA             | 2  | Gdi II    | `YGGC,CG        | 12 |
| Gsu I    | CTGGAG 21/19        | 2  | Hae I     | WGG CCW         | 7  |
| Hae II   | R,GCGC`Y            | 7  | Hae III   | GG CC           | 20 |
| Hga I    | GACGC 9/14          | 6  | HgiA I    | G,WGCW`C        | 6  |
| HgiE II  | ACCNNNNNNGGT -1/133 |    | Hha I     | G,CG`C          | 31 |
| Hinc II  | GTY RAC             | 1  | Hind II   | GTY RAC         | 1  |
| Hind III | A`AGCT,T            | 1  | Hinf I    | G`ANT,C         | 13 |
| HinI I   | GR`CG,YC            | 4  | HinP I    | G`CG,C          | 31 |
| Hpa I    | GTT AAC             | -  | Hpa II    | C`CG,G          | 31 |
| Hph I    | GGTGA 12/11         | 6  | Kas I     | G`GCGC,C        | 3  |
| Kpn I    | G,GTAC`C            | 1  | Mae I     | C`TA,G          | 9  |
| Mae II   | A`CG,T              | 9  | Mae III   | `GTNAC,         | 16 |
| Mbo I    | `GATC,              | 21 | Mbo II    | GAAGA 12/11     | 11 |
| Mlu I    | A`CGCG,T            | 1  | Mme I     | TCCRAC 25/23    | 2  |
| Mnl I    | CCTC 10/10          | 31 | Msc I     | TGG CCA         | 2  |
| Mse I    | T`TA,A              | 16 | Msl I     | CAYNN NNRTG     | 4  |
| Msp I    | C`CG,G              | 31 | MspA1 I   | CMG CKG         | 7  |
| Mun I    | C`AATT,G            | 1  | Nae I     | GCC GGC         | 3  |
| Nar I    | GG`CG,CC            | 3  | Nci I     | CC`S,GG         | 10 |
| Nco I    | C`CATG,G            | 3  | Nde I     | CA`TA,TG        | 1  |
| NgoM I   | G`CCGG,C            | 3  | Nhe I     | G`CTAG,C        | 1  |
| Nla III  | ,CATG`              | 21 | Nla IV    | GGN NCC         | 18 |
| Not I    | GC`GGCC,GC          | 1  | Nru I     | TCG CGA         | -  |
| Nsi I    | A,TGCA`T            | -  | Nsp7524 I | R`CATG,Y        | 6  |
| NspB II  | CMG CKG             | 7  | NspH I    | R,CATG`Y        | 6  |
| PaeR7 I  | C`TCGA,G            | -  | Pal I     | GG CC           | 20 |
| PflM I   | CCAN,NNN`NTGG       | -  | Ple I     | GAGTC 9/10      | 3  |
| Pme I    | CTTT AAAC           | 2  | Pml I     | CAC GTG         | -  |
| PpuM I   | RG`GWC,CY           | -  | Psp1406 I | AA`CG,TT        | 2  |
| PspA I   | C`CCGG,G            | -  | Pst I     | C,TGCA`G        | 1  |
| Pvu I    | CG,AT`CG            | -  | Pvu II    | CAG CTG         | 4  |
| Rsa I    | GT AC               | 6  | Rsr II    | CG`GWC,CG       | 2  |
| Sac I    | G,AGCT`C            | -  | Sac II    | CC,GC`GG        | -  |
| Sal I    | G`TCGA,C            | 1  | Sap I     | GCTCTTC 8/11    | 5  |
| Sau3A I  | `GATC,              | 21 | Sau96 I   | G`GNC,C         | 5  |
| Sca I    | AGT ACT             | -  | ScrF I    | CC`N,GG         | 16 |
| Sec I    | C`CNNG,G            | 9  | SfaN I    | GCATC 9/13      | 24 |
| Sfc I    | C`TRYA,G            | 4  | Sfi I     | GGCCN,NNN`NGGCC | -  |
| Sma I    | CCC GGG             | -  | SnaB I    | TAC GTA         | -  |
| Spe I    | A`CTAG,T            | -  | Sph I     | G,CATG`C        | 3  |
| Spl I    | C`GTAC,G            | -  | Srf I     | GCCC GGGC       | -  |
| Ssp I    | AAT ATT             | -  | Stu I     | AGG CCT         | 2  |
| Sty I    | C`CWVG,G            | 4  | Taq I     | T`CG,A          | 19 |

*pHDR Vector*

|          |             |   |           |                    |    |
|----------|-------------|---|-----------|--------------------|----|
| Tfi I    | G`AWT,C     | 6 | Tsp45 I   | `GTSAC,            | 9  |
| Tth111 I | GACN`N,NGTC | 3 | Tth111 II | CAARCA 16/14       | 8  |
| Vsp I    | AT`TA,AT    | - | Xba I     | T`CTAG,A           | 2  |
| Xca I    | GTA TAC     | 1 | Xcm I     | CCANNNN,N`NNNNTGG- |    |
| Xho I    | C`TCGA,G    | - | Xho II    | R`GATC,Y           | 12 |
| Xma I    | C`CCGG,G    | - | Xma III   | C`GGCC,G           | 3  |