STONE & WEBSTER ENGINEERING CORPORATION

# CALCULATION TITLE PAGE

| 'ENT & PROJECT | | | | PAGE 1 OF 8 | | |
|---|---|---|---|---|---|---|
| PFSLLC / PRIVATE FUEL STORAGE FACILITY | | | | | | |
| CALCULATION TITLE<br>**PFSF Rail Line - Determination of Drainage Basin Areas** | | | | QA CATEGORY (X)<br>___ I - NUCLEAR SAFETY RELATED<br>___ II _X_ III ___ OTHER | | |
| CALCULATION IDENTIFICATION NUMBER | | | | | | |
| J.O. OR W.O. NO. | DIVISION & GROUP | CURRENT CALC. NO. | OPTIONAL TASK CODE | OPTIONAL WORK PACKAGE NO. | | |
| 05996.02 | CIVIL | SY-10 | NA | NA | | |
| APPROVALS - SIGNATURE & DATE | | | REV. NO. OR NEW CALC. NO | SUPERSEDES CALC. NO. OR REV. NO. | CONFIRMATION REQUIRED (X) | |
| PREPARER(S)/DATE(S) | REVIEWER(S)/DATE(S) | INDEPENDENT REVIEWER(S)/DATE(S) | | | YES | NO |
| C.HURLEY<br>7/16/1999 | Timothy Hughes<br>8/10/1999 | | 0 | NA | | X |

DISTRIBUTION

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| CALCULATION SHEET | J.O./W.O./CALCULATION NO. | REVISION | PAGE |
|---|---|---|---|
| | 05996.02-SY-10 | 0 | 2 |

| PREPARER/DATE | REVIEWER/CHECKER/DATE | INDEPENDENT REVIEWER |
|---|---|---|
| CFH 7/16/99 | T.Hughes 8/10/99 | N/A |

| SUBJECT/TITLE | QA CATEGORY/CODE CLASS |
|---|---|
| SF Rail Line – Determination of Drainage Basin Areas | III |

## TABLE OF CONTENTS AND HISTORICAL DATA

**(Revisions, Additions, Deletions, Etc.)**

## RECORD OF REVISIONS

**REVISION 0**

Original Issue

## CALCULATION SUMMARY

### OBJECTIVE OF CALCULATION:

The purpose of this calculation is to determine areas of drainage basins leading to the proposed alignment of the PFSF rail line for use in sizing drainage structures along the line.

### CALCULATION METHOD/ASSUMPTIONS:

Drainage areas were marked on quadrangle maps of the area. Next these maps were scanned and imported into ACAD where they were scaled up appropriately. The areas were then calculated using the software. Sample areas were calculated on several of the Quad maps in order to verify accuracy.
The slopes were determined by digitizing the intermittent stream information off of the quadrangle maps and getting length from the results using ACAD.

### SOURCES OF DATA/EQUATIONS:

The following USGS quanrangle were used to determine drainage basins:
N4045-W11252.5/7.5 (Low) - 1973
N4045-W11245/7.5 (Delle) - 1973
N4037.5-W11252.5/7.5 (Hastings Pass) - 1973
N4037.5-W11245/7.5 (Hastings Pass NE) - 1973
N4030-W11252.5/7.5 (Quincy Spring) - 1973
N4030-W11245/7.5 (Hastings Pass SE) - 1973
40112-D8-TF-024 (Tabbys Peak) - 1993
40112-D7-TF-024 (Hickman Knolls) – 1993

The following S&W drawings were used:
0599602-EY-11-A
0599602-EY-12-A
0599602-EY-13-A

The following digital files were produced in production of this calculation:
C:\craiger\0599602\all.dwg
C:\craiger\0599602\pfsf drainage areas.xls
C:\craiger\0599602\059960SY10.doc

### CONCLUSIONS:

The basin areas are given in acres on the table below. The data used to determine the slope of the basins is also included. Many of the areas have two slopes associated with them, with a steep decent from the foothills out into the decreased grade at the valley floor. Where there are basins with two or more flow paths and only one area associated with them, this indicates that the area is to be divided equally among them. These areas

may also need berms or other structures to force the drainage into a channel to cross the rail.

Basin N is the area where the potential for a bridge exists.

A diagram showing the location of each area and the associated drainage paths is attached.

The far southern basins are analyzed in Calculations G(B)-12, G(B)-16, and G(B)-17 (J.O.#05996.02).

The first table breaks the basins down into areas where distinctly different slopes were encountered. The second table simply gives an average slope and longest flowpath for the whole basin.

Drainage Basin Areas

| Basin ID | Area (SF) | Area (acre) | Basin Flow Path Info | | | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | Begin Elev. | End Elev. | Elev. chg. | Length | Slope | |
| A | 38,202,500 | 877 | 5,000 | 4,610 | 390 | 7,587 | 0.0514 | |
| B(1) | 16,041,905 | 368 | 4,800 | 4,610 | 190 | 3,090 | 0.0615 | 1/2 area to B(1,2); not well defined path near rail |
| B(2) | | | 4,960 | 4,610 | 350 | 3,044 | 0.1150 | |
| C | 49,922,742 | 1,146 | 4,940 | 4,480 | 460 | 7,459 | 0.0617 | |
| D | 146,584,174 | 3,365 | 5,980 | 5,000 | 980 | 9,473 | 0.1035 | 1 flow path w/ 2 slopes |
| | | | 5,000 | 4,410 | 590 | 12,707 | 0.0464 | |
| E | 33,364,047 | 766 | 4,900 | 4,400 | 500 | 7,720 | 0.0648 | |
| F | 9,114,564 | 209 | 4,770 | 4,390 | 380 | 5,641 | 0.0674 | |
| G | 66,765,758 | 1,533 | 5,930 | 4,380 | 1,550 | 18,409 | 0.0842 | |
| H(1) | 28,988,683 | 665 | 5,360 | 4,800 | 560 | 2,415 | 0.2319 | 1 flow path w/ 2 slopes |
| | | | 4,800 | 4,380 | 420 | 5,079 | 0.0827 | |
| H(2) | 59,254,439 | 1,360 | 5,260 | 4,340 | 920 | 6,395 | 0.1439 | H(3) has 1 path w/ 2 slopes;H(2,3) drain into not well defined flow paths |
| H(3) | | | 5,800 | 4,800 | 1,000 | 5,406 | 0.1850 | |
| | | | 4,800 | 4,360 | 440 | 5,055 | 0.0870 | |
| I | 76,812,893 | 1,763 | 6,000 | 5,400 | 600 | 8,285 | 0.0724 | 1 flow path w/ 2 slopes |
| | | | 5,400 | 4,350 | 1,050 | 16,632 | 0.0631 | |
| J | 55,256,404 | 1,269 | 5,220 | 4,360 | 860 | 10,962 | 0.0785 | |
| K | 43,678,158 | 1,003 | 5,460 | 5,300 | 160 | 2,263 | 0.0707 | 1 flow path w/ 2 slopes |
| | | | 5,300 | 4,360 | 940 | 16,263 | 0.0578 | |
| L | 63,808,618 | 1,465 | 5,860 | 5,000 | 860 | 10,933 | 0.0787 | 1 flow path w/ 2 slopes |
| | | | 5,000 | 4,380 | 620 | 12,845 | 0.0483 | |
| M | 59,670,083 | 1,370 | 5,200 | 4,480 | 720 | 19,239 | 0.0374 | |
| N(1) | 211,161,426 | 4,848 | 5,880 | 5,000 | 880 | 6,529 | 0.1348 | N(1) has 1 flow path w/2 slopes; N(1,2,3,) drain into N(All) flow path |
| | | | 5,000 | 4,520 | 480 | 20,462 | 0.0235 | |
| N(2) | | | 5,200 | 4,520 | 680 | 13,995 | 0.0486 | |
| N(3) | | | 5,000 | 4,520 | 480 | 9,167 | 0.0524 | |
| N(All) | | | 4,520 | 4,400 | 120 | 6,491 | 0.0185 | |
| O | 10,266,993 | 236 | 4,600 | 4,460 | 140 | 5,187 | 0.0270 | |
| P(N) | 24,997,536 | 574 | 4,800 | 4,450 | 350 | 6,046 | 0.0579 | 1/2 area to P(N,S); not well defined path near rail |
| P(S) | | | 4,660 | 4,460 | 200 | 5,741 | 0.0348 | |
| Q(1) | 174,589,932 | 4,008 | 5,940 | 5,200 | 740 | 15,718 | 0.0471 | Q(1,2) combine to form Q(N). Q (N,S) combine approx. @ rail |
| Q(2) | | | 6,230 | 5,200 | 1,030 | 10,997 | 0.0937 | |
| Q(N) | | | 5,200 | 4,390 | 810 | 24,644 | 0.0329 | |
| Q(S) | | | 4,950 | 4,390 | 560 | 17,922 | 0.0312 | |
| R | 58,684,751 | 1,347 | 5,280 | 4,350 | 930 | 25,107 | 0.0370 | |
| S | 27,380,971 | 629 | 4,600 | 4,370 | 230 | 8,407 | 0.0274 | |
| T | 12,103,639 | 278 | 4,540 | 4,360 | 180 | 7,628 | 0.0236 | |
| U | 237,111,231 | 5,443 | 5,700 | 5,200 | 500 | 2,747 | 0.1820 | 1 flow path w/ 2 slopes; path gives typ. slopes for area |
| | | | 5,200 | 4,350 | 850 | 25,738 | 0.0330 | |
| V(1) | 116,511,918 | 2,675 | 4,800 | 4,360 | 440 | 10,293 | 0.0427 | 2 Sep. paths; both join near rail;each uses 1/2 area V(1) |
| | | | 4,800 | 4,360 | 440 | 11,935 | 0.0369 | |
| V(2) | 404,746,832 | 9,292 | 6,400 | 5,400 | 1,000 | 7,742 | 0.1292 | 1 flow path w/ 2 slopes |
| | | | 5,400 | 4,380 | 1,020 | 27,915 | 0.0365 | |
| W(1) | 670,464,772 | 15,392 | 5,740 | 4,750 | 990 | 17,108 | 0.0579 | W(1,2,3) are 3 samples of terrain; W(2,3) have 2 slopes per path; W(4,5,6,7) are samples @ part w/ no well defined flow paths |
| W(2) | | | 6,400 | 5,460 | 940 | 8,736 | 0.1076 | |
| | | | 5,460 | 4,750 | 710 | 15,145 | 0.0469 | |
| W(3) | | | 6,660 | 5,600 | 1,060 | 19,410 | 0.0546 | |
| | | | 5,600 | 5,000 | 600 | 13,972 | 0.0429 | |
| W(4) | | | 5,000 | 4,750 | 250 | 9,476 | 0.0264 | |
| W(5) | | | 4,750 | 4,380 | 370 | 12,393 | 0.0299 | |
| W(6) | | | 4,750 | 4,380 | 370 | 11,716 | 0.0316 | |
| W(7) | | | 5,000 | 4,380 | 620 | 18,415 | 0.0337 | |
| X | 46,005,844 | 1,056 | 4,740 | 4,360 | 380 | 13,880 | 0.0274 | |
| Y(1) | 626,775,123 | 14,389 | 5,220 | 4,840 | 380 | 3,905 | 0.0973 | Y(1,2,3) all have 2 slopes on a single flowpath. The flowpaths are not well defined as they approach rail |
| | | | 4,840 | 4,350 | 490 | 19,567 | 0.0250 | |
| Y(2) | | | 6,440 | 5,000 | 1,440 | 14,796 | 0.0973 | |
| | | | 5,000 | 4,380 | 620 | 20,420 | 0.0304 | |
| Y(3) | | | 5,800 | 5,000 | 800 | 6,484 | 0.1234 | |
| | | | 5,000 | 4,380 | 620 | 25,280 | 0.0245 | |
| Z | 565,757,104 | 12,988 | 6,520 | 5,300 | 1,220 | 20,719 | 0.0589 | 1 flow path w/ 2 slopes |
| | | | 5,300 | 4,385 | 915 | 38,760 | 0.0236 | |

TABLE I

| Basin ID | Area (SF) | Area (acre) | Basin Flow Path Info | | | | |
|---|---|---|---|---|---|---|---|
| | | | Begin Elev. | End Elev. | Elev. chg. | Length | Slope |
| A | 38,202,500 | 877 | 5,400 | 4,610 | 790 | 11,637 | 0.0679 |
| B | 16,041,905 | 368 | 5,120 | 4,610 | 510 | 6,772 | 0.0753 |
| C | 49,922,742 | 1,146 | 5,020 | 4,480 | 540 | 7,801 | 0.0692 |
| D | 146,584,174 | 3,365 | 6,500 | 4,410 | 2,090 | 24,040 | 0.0869 |
| E | 33,364,047 | 766 | 5,080 | 4,400 | 680 | 9,317 | 0.0730 |
| F | 9,114,564 | 209 | 4,900 | 4,390 | 510 | 7,303 | 0.0698 |
| G | 66,765,758 | 1,533 | 6,020 | 4,380 | 1,640 | 19,983 | 0.0821 |
| H(1) | 28,988,683 | 665 | 6,200 | 4,380 | 1,820 | 8,644 | 0.2106 |
| H | 59,254,439 | 1,360 | 6,100 | 4,360 | 1,740 | 11,398 | 0.1527 |
| I | 76,812,893 | 1,763 | 6,400 | 4,350 | 2,050 | 26,164 | 0.0784 |
| J | 55,256,404 | 1,269 | 6,120 | 4,360 | 1,760 | 13,542 | 0.1300 |
| K | 43,678,158 | 1,003 | 6,060 | 4,360 | 1,700 | 20,201 | 0.0842 |
| L | 63,808,618 | 1,465 | 6,060 | 4,380 | 1,680 | 26,860 | 0.0625 |
| M | 59,670,083 | 1,370 | 5,740 | 4,390 | 1,350 | 20,785 | 0.0650 |
| N(1) | 211,161,426 | 4,848 | 6,080 | 4,400 | 1,680 | 35,108 | 0.0479 |
| O | 10,266,993 | 236 | 4,972 | 4,360 | 612 | 6,533 | 0.0937 |
| P | 24,997,536 | 574 | 4,972 | 4,350 | 622 | 7,085 | 0.0878 |
| Q | 174,589,932 | 4,008 | 6,120 | 4,390 | 1,730 | 43,397 | 0.0399 |
| R | 58,684,751 | 1,347 | 6,010 | 4,350 | 1,660 | 28,629 | 0.0580 |
| S | 27,380,971 | 629 | 5,000 | 4,370 | 630 | 10,434 | 0.0604 |
| T | 12,103,639 | 278 | 4,565 | 4,360 | 205 | 7,968 | 0.0257 |
| U | 237,111,231 | 5,443 | 6,260 | 4,350 | 1,910 | 33,982 | 0.0562 |
| V(1) | 111,244,237 | 2,554 | 5,120 | 4,330 | 790 | 14,950 | 0.0528 |
| V(2) | 394,877,891 | 9,065 | 6,900 | 4,350 | 2,550 | 37,960 | 0.0672 |
| W | 685,613,907 | 15,740 | 6,660 | 4380 | 2,280 | 51,797 | 0.0440 |
| X | 46,005,844 | 1,056 | 4,860 | 4,360 | 500 | 18,289 | 0.0273 |
| Y | 626,775,123 | 14,389 | 6,910 | 4,380 | 2,530 | 36,235 | 0.0698 |
| Z | 565,757,104 | 12,988 | 6,740 | 4,385 | 2,355 | 60,247 | 0.0391 |

**TABLE II**

**CHECK OF METHODOLOGY:**

A verification of the accuracy of the areas determined from the scanned images was performed by checking the area of a section. The section used was Section 21 T1N R10W on the Low Quadrangle.

Area as determined by CAD: 27,822,350 SF
Actual Area: 27,878,400 SF
Error: 0.2% ⇒⇒ O.K.

STONE & WEBSTER ENGINEERING CORPORATION

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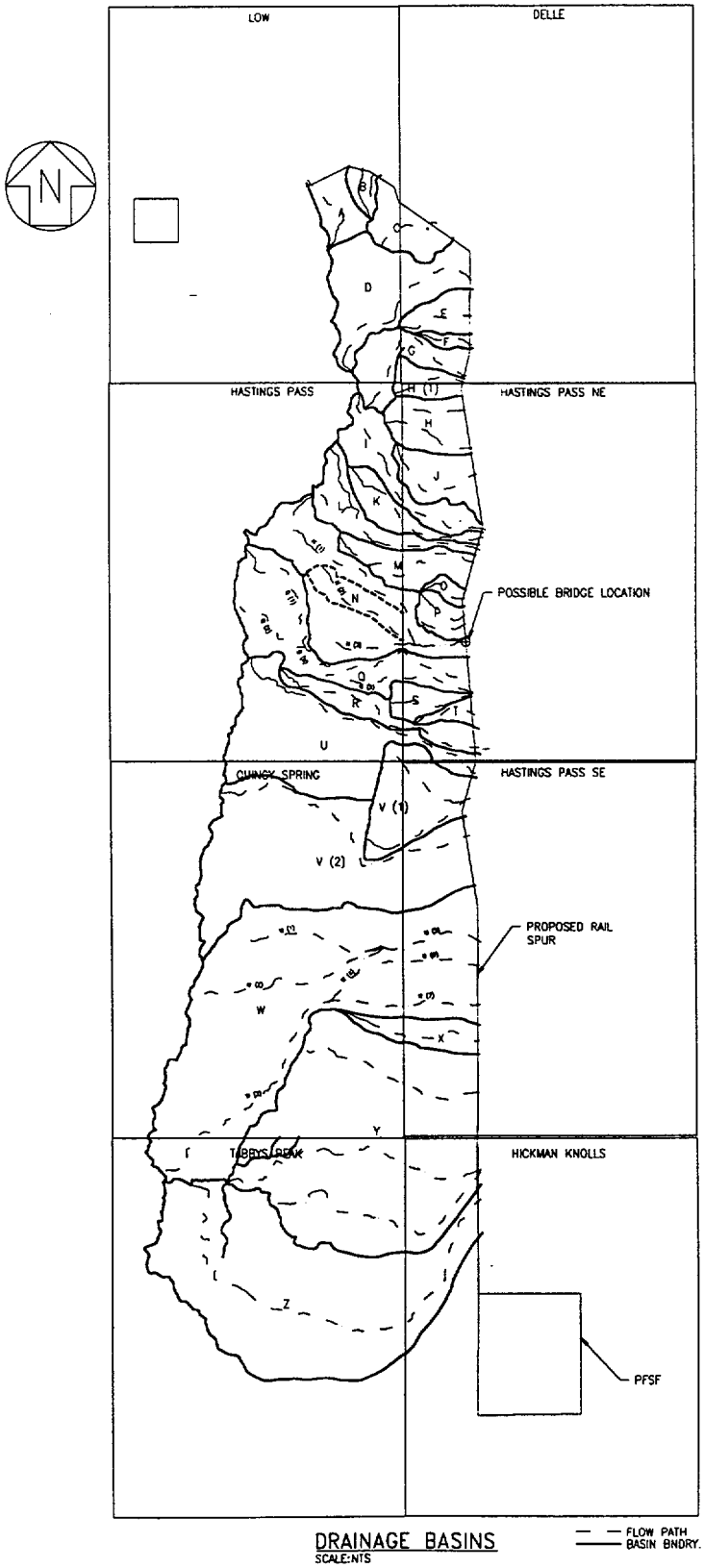
| ATE 7/16/99 | REVIEWER/CHECKER/DATE T.Hughes 8/10/99 | INDEPENDENT REVIEWER N/A | |
| JBJECT/TITLE FSF Rail Line – Determination of Drainage Basin Areas | | QA CATEGORY/CODE CLASS III | |




DRAINAGE BASINS
SCALE: NTS

— — FLOW PATH
—— BASIN BNDRY.