

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

DIGITAL TERRAIN IN THE BETHEL, RUSSIAN MISSION, AND  
GOODNEWS BAY 1°x3° QUADRANGLES, ALASKA, INCLUDING  
IMPROVED TERRAIN FOR PARTS OF THESE QUADRANGLES

By

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*93-702-A, Documentation*

*93-702-B, Terrain Data on Diskette*

Open-File Report 93-702-A

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Menlo Park, California  
1993

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## INTRODUCTION

Alaska digital terrain files are used for many purposes. The more common uses in the Geophysics Branch of the U.S. Geological Survey (USGS) are making topographic profiles for modeling, making topographic contour, gray shade, or color maps, and for calculating terrain corrections for gravity data. These terrain files were produced originally mostly from manuscript 1:250,000 scale USGS topographic maps derived from 1:63,360 scale USGS topographic maps. In the course of making terrain corrections for gravity data in the Bethel, Alaska quadrangle, unexpectedly large terrain corrections in parts of the study area suggested possible errors in these terrain files. This report will explain the techniques used for checking and updating Alaska digital terrain files. Figure 1 shows the location of the study area.

## TYPES OF TERRAIN FILES

The original files that were received for the Alaska terrain had average elevations for compartments which were 3 seconds in latitude and 6 seconds in longitude. These  $1^{\circ} \times 1^{\circ}$  files are available through the USGS Earth Science Information Centers. These were converted to be used for our digital terrain correction program which requires three different files of terrain. The files, which were generated from the  $3 \times 6$  second data, contain  $\frac{1}{4} \times \frac{1}{2}$ ,  $1 \times 2$ , and  $3 \times 6$  minute terrain digitization. Each  $\frac{1}{4} \times \frac{1}{2}$  minute compartment contains 25  $3 \times 6$  second compartments. Each  $1 \times 2$  minute compartments contain 400  $3 \times 6$  second compartments and each  $3 \times 6$  minute compartment contains 3600  $3 \times 6$  second compartments.

## CHECKING TERRAIN FILES

One technique for testing the accuracy of digital terrain files is to contour the difference between map elevations and interpolated digital terrain elevations at the same location. The procedure is to compare a file with locations and elevations with the  $\frac{1}{4} \times \frac{1}{2}$  terrain files covering the study area. The locations are used to interpolate elevations from the terrain file and calculate the difference with the map elevations and produce a contour map of these differences.

When terrain corrections were calculated for gravity data for the Bethel study area, unexpectedly large inner-zone gravity terrain corrections were calculated in the mountainous areas. This lead to comparing gravity station elevations with interpolated digital terrain. The resultant contour map of elevation differences revealed errors in the eastern part of the study area. Differences were as large as 2000 feet.

A contour map was then made from the digital terrain of the study area. This map compared well with contours on the Alaska 1:250,000 scale reconnaissance series which preceded the current topographic series. The reconnaissance series were compiled from original USGS surveys from 1898-1951 and supplemented by photoalidade compilation from 1941-1947. Both the horizontal and vertical control for these maps was not as good as the current topographic series. When the contoured terrain map was compared to the current topographic series map, a lateral shift was observed. The basic shape of the mountains were the same, but these lateral shifts in rugged terrain accounted for much of the elevation differences that were observed. Most of the reconnaissance maps in the study area, especially in mountainous terrain have contour intervals of 1000 feet, some of which are dashed, meaning that there is uncertainty in their locations.

Gravity data collected for the Bethel project were located on 1:63,360 scale topographic series maps published in 1952, 1954, and 1979. The area covered by 1979 maps cover the area where the large elevation differences were found because they were not available when the digital data were produced.

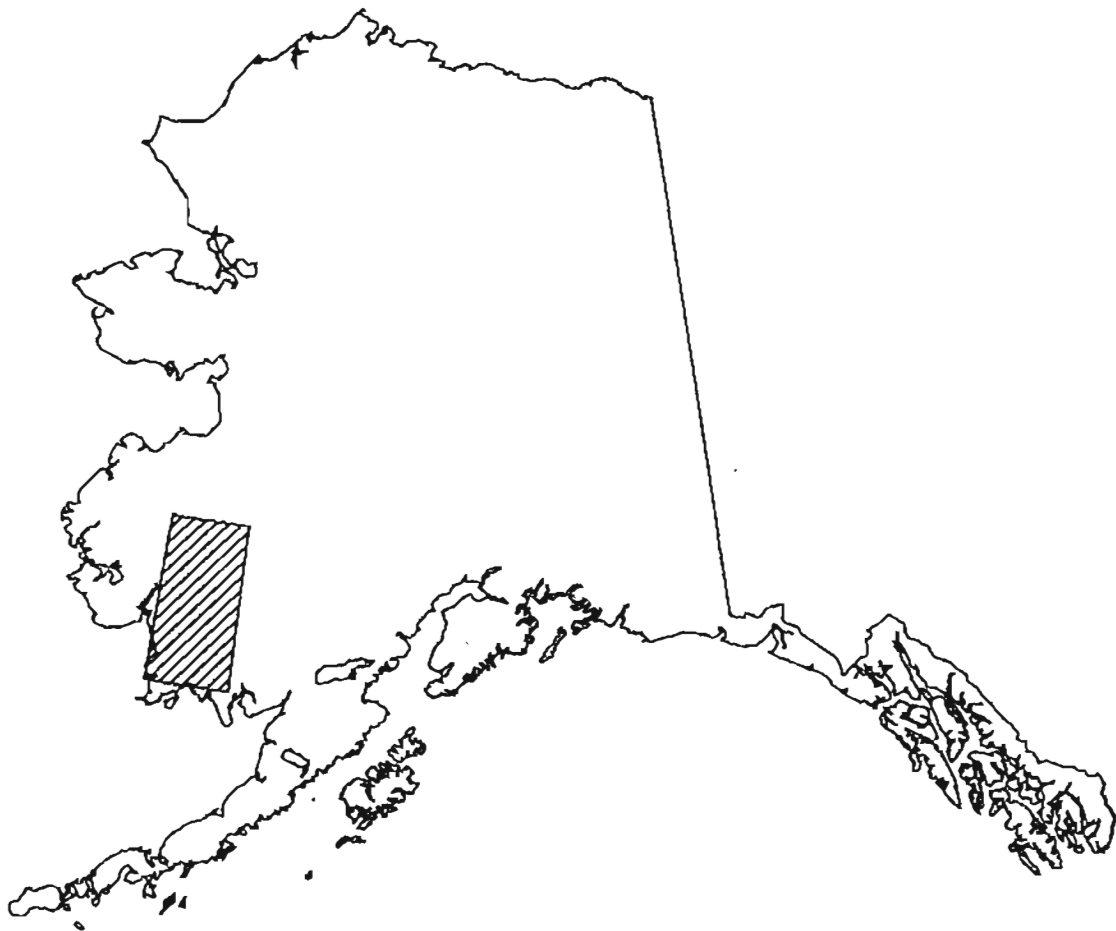


FIGURE 1. -Location of study area. Shown are the boundaries of Russian Mission, Bethel, and Goodnews Bay 1°x3° quadrangles, Alaska.

## MISSING TOPOGRAPHIC MAPS

In southwestern Alaska, there are three 1:250,000 scale quadrangles that did not have complete 1:63,360 scale topographic coverage at the time of the digital elevation program. These were the Bethel, Goodnews (now Goodnews Bay), and Russian Mission 1°x3° quadrangles. For Bethel the unavailable maps were the A-1,2,3; B-1,2; C-1,2; and D-1,2 15 minute quadrangles. For Russian Mission they were the A-1,2 15 minute quadrangles. For Goodnews they were the A-1,2,5; B-1,2,4,5; C-1,3,5; and D-1,2,3 15 minute quadrangles.

Gravity surveys were conducted as part of a mineral resource appraisal of the Bethel 1°x3° quadrangle. The southern 15 minutes of the Russian Mission 1°x3° quadrangle was also included in the project. Terrain corrections used for gravity data reduction were made for all data within the study area. To improve the accuracy of the terrain corrections, parts of the 1979 topographic maps were digitized by hand in areas where the contour map of elevation differences showed elevation differences that exceed 300 feet.

## AREAS OF IMPROVED DIGITAL TERRAIN

The  $\frac{1}{4} \times \frac{1}{2}$  minute compartments of average elevations are stored in 10x20 minute blocks in a file which contains 18 blocks in a 1°x1° area. From these, the 1x2 minute and the 3x6 minute files of average elevations are calculated. Generally, entire 10x20 minute blocks were digitized, but if only parts were digitized, they were then merged with the preexisting files. Additional improved terrain data was needed in the northern Goodnews Bay quadrangle, but much of the Goodnews Bay data in the areas covered by 1979 mapping have not been updated. Figure 2 shows the location of the 1979 topographic maps within the Russian Mission, Bethel, and Goodnews Bay 1°x3° quadrangles and the areas within them that have been digitized and used to update the terrain files with improved digital terrain.

## UPDATED FILES

After the areas for digitizing were determined the, 1:63,360 scale topographic maps were lined off in  $\frac{1}{4}$  minute high by  $\frac{1}{2}$  minute wide compartments. Elevations were then estimated for each of these compartments. The data was then typed into computer files. Where the 10x20 minute blocks were completely digitized, the newer blocks replaced the older ones. Where only parts of the blocks were digitized, the newer elevations replaced the older ones.

Included on the diskette are the  $\frac{1}{4} \times \frac{1}{2}$  minute, 1x2 minute, and 3x6 minute terrain for the Russian Mission, Bethel, and Goodnews Bay 1:250,000 scale quadrangles. The  $\frac{1}{4} \times \frac{1}{2}$  minute terrain is stored in 18 10x20 minute blocks in a file that contains data for a 1°x1° area. Three modified files are included in this data. They are 59x159.mqm, 60x159.mqm, and 61x159.mqm. The 1x2 minute data is stored in two 30x60 minute blocks also stored in 1°x1° files. They have been updated to reflect the newer quarter minute data. Included are 59x159.m1m, 60x159.m1m, and 61x159.m1m. The 3x6 minute terrain is stored in one block of data 60x120 minutes (1°x2°). Because the 3x6 minute terrain is stored in 1x2 degree files, the western one degree of Sleetmute, Taylor Mountains, and Dillingham 1:250,000 scale quadrangles are part of the data. Included are the updated files 59x158.q3m, 60x158.q3m, and 61x158.q3m. The names of each files indicate the southeast corner of the data contained in them.

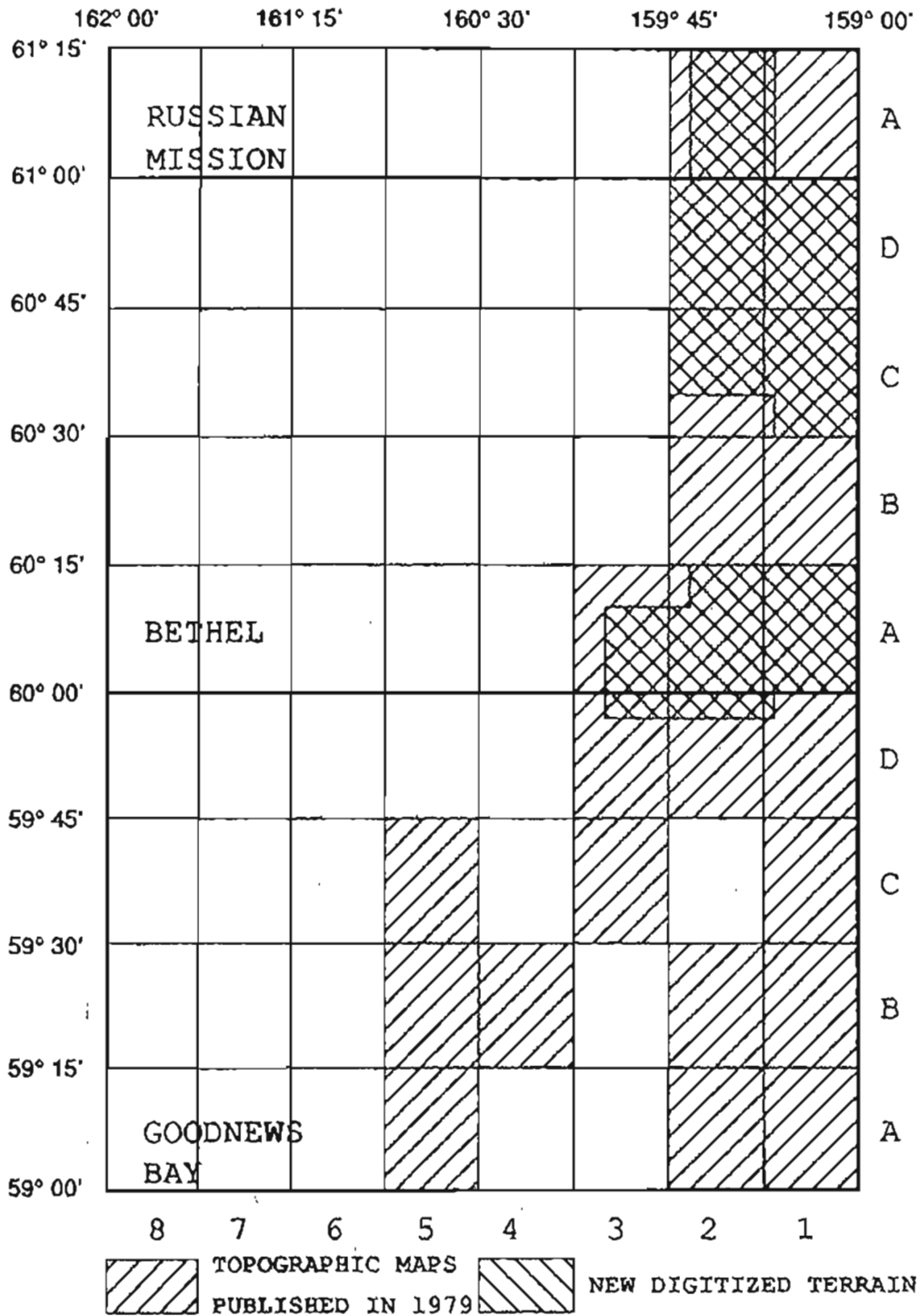


FIGURE 2. -Index map of 1:63,360 scale topographic maps published in 1979 in the Bethel, Russian Mission, and Goodnews Bay 1°x3° quadrangles, Alaska which were not available when the digital elevation files were produced. Also shown is the area of updated  $\frac{1}{4} \times \frac{1}{2}$  minute terrain.



## READING DISKETTES

The data described in this report are available as Open-File Report 93-702-B. These data are on two 3½-inch, high-density, and double-sided diskette formatted for IBM personal computers. The diskette requires the following hardware: (1) an IBM personal computer or compatible computer operating PC-DOS or MS-DOS, and (2) a double-sided high-density disk drive.

Diskette 1 contains a total of 10 files:

*README.TXT*, a description of the terrain data;  
*59x159.MQM*, quarter minute terrain;  
*60x159.MQM*, quarter minute terrain;  
*61x159.MQM*, quarter minute terrain;  
*59x160.MQM*, quarter minute terrain;  
*60x160.MQM*, quarter minute terrain;  
*61x160.MQM*, quarter minute terrain;  
*59x161.MQM*, quarter minute terrain;  
*60x161.MQM*, quarter minute terrain;  
*61x161.MQM*, quarter minute terrain;

Diskette 2 contains a total of 15 files:

*59x159.M1M*, one minute terrain;  
*60x159.M1M*, one minute terrain;  
*61x159.M1M*, one minute terrain;  
*59x160.M1M*, one minute terrain;  
*60x160.M1M*, one minute terrain;  
*61x160.M1M*, one minute terrain;  
*59x161.M1M*, one minute terrain;  
*60x161.M1M*, one minute terrain;  
*61x161.M1M*, one minute terrain;  
*59x158.Q3M*, three minute terrain;  
*60x158.Q3M*, three minute terrain;  
*61x158.Q3M*, three minute terrain;  
*59x160.Q3M*, three minute terrain;  
*60x160.Q3M*, three minute terrain;  
*61x160.Q3M*, three minute terrain;

U.S. Geological Survey  
Open-File Report 93-702

Digital terrain in the Bethel, Russian Mission, and Goodnews Bay 1 degree X 3 degree quadrangles, Alaska, including improved terrain for parts of these quadrangles

README.TXT

Three types of terrain files are on these diskettes (1 and 2) in ASCII format: 1/4x1/2 minute, 1x2 minute, and 3x6 minute. Each file contains blocks of data. A header line is located at the beginning of each block. This lists information about the block of terrain data that follows. The format is the same for each block whether 1/4-, 1/2-, or 1- minute data follows.

Column	Format	Contents of header line
1-12	A12	The label of the original magnetic tape with 3x6 second terrain or, in the case of new or merged terrain, a "tag" indicating the name of the 1:250,000 quadrangle and the scale of the map that was digitized (1:63 meaning 1:63,360)
13-15	I3	Latitude degrees of the northwest corner of the data block
16-18	I3	Latitude minutes of the northwest corner of the data block
19-22	I4	Longitude degrees of the northwest corner of the data block
23-25	I3	Longitude minutes of the northwest corner of the data block
26	I1	Unit for positive elevations: 0 or 1 for feet, 3 for meters
27	I1	Unit for negative elevations: 3 for meters, 6 for fathoms
28-32	I5	Maximum compartment elevation in the data block (for unmodified terrain blocks)
33-37	I5	Minimum compartment elevation in the data block (for unmodified terrain blocks)
38-39	2X	Spaces
40-47	A8	The date the new or merged file was generated or the date the 3x6 second data was converted to this format
48-55	A8	Comment-- merge= new and old data merged, 1714.1= time of original reading, blank= all new data (1/4x1/2 minute only)

READING THE 1/4X1/2-MINUTE DATA (diskette 1)

Each file of 1/4x1/2 minute elevations contains terrain data for a 1 degree by 1 degree area. Each of 18 "blocks" of data in the files contain data in a 10 minutes of latitude by 20 minutes of longitude area. Following each header line are 160 lines of data in a "10I5" format. The data start at the northwest corner of the block. Each line of data contains 10 elevations covering 5 minutes of longitude. Four lines of data represent 20 minutes of data arranged from west to

READING THE 1X2-MINUTE DATA (diskette 2)

Each file of 1x2 minute elevations contains terrain data for a 1 degree by 1 degree area. Each of two "blocks" of data in the files contain data in a 30 minutes of latitude by 60 minutes of longitude. Following each header line are 90 lines of data in a "10I5" format. The data start at the northwest corner of the block. Each line of data contains 10 elevations covering 20 minutes of longitude. Three lines of data represent 1 degree of data arranged from west to east.

READING THE 3X6-MINUTE DATA (diskette 2)

Each file of 3x6 minute elevations contains terrain data for a 1 degree by 2 degree area. There is one "block" of data in each file. Following the header line are 40 lines of data in a "10I5" format. The data start at the northwest corner of the block. Each line of data contains 10 elevations covering 60 minutes of longitude. Two lines of data represent 2 degrees of data arranged from west to east.

Example of part of a block of a 1/4x1/2 minute terrain file

	1	2	3	4	5	
1234567890123456789012345678901234567890123456789012345						
GOOD	1:63	60	0 160	016	03/21/91	merge
2700	2600	2600	2600	2600	2000	1700 1800 2300 2700
2300	2000	1600	1500	1400	1300	1300 1300 1300 1200
1200	1200	1200	1200	1300	1300	1400 1500 1600 1600
1500	1500	1600	1600	1600	2000	2200 2400 2300 2500
2500	2800	2900	3100	2800	2100	1700 1900 2500 2900
2500	2300	2000	2100	1700	1500	1300 1200 1200 1200
1200	1200	1200	1200	1300	1300	1300 1400 1400 1400
1500	1500	1500	1500	1500	1700	1900 2200 2300 2300
2500	3100	3200	3000	2600	2000	1700 2100 2900 3000
2800	2300	2300	2600	2100	2000	1400 1200 1200 1100
1100	1100	1200	1200	1300	1300	1400 1500 1500 1500
1600	1500	1500	1500	1500	1500	1600 1700 1800 2000
2400	2800	2900	2700	2200	1800	1800 2300 3000 3300
2900	2300	2700	3000	2800	2500	1800 1300 1200 1100
1100	1100	1200	1200	1300	1300	1400 1500 1600 1600
1500	1400	1500	1600	1700	1700	1600 1600 1600 1700
2200	2500	2500	2400	2000	1800	1800 2400 3200 3500
2700	2500	3100	3300	3100	2700	2000 1600 1200 1100
1100	1100	1200	1200	1300	1300	1400 1400 1500 1600
1500	1400	1500	1700	1900	1900	1800 1700 1700 1600
2200	2300	2300	2200	2000	1900	1900 2300 3100 3500
2800	3100	3300	3200	2800	2500	2500 1800 1400 1300
1100	1000	1100	1200	1300	1300	1300 1400 1400 1400
1400	1400	1700	2000	2200	2100	2000 1900 1800 1600
2400	2400	2300	2300	2200	1900	1900 2300 2800 3300
3100	3200	3200	2900	3000	3000	2400 1700 1500 1400
1200	1000	1000	1100	1200	1300	1300 1300 1300 1300
1400	1500	1700	2100	2200	2200	2200 2200 2100 1900
2400	2600	2500	2400	2200	2000	2000 2300 2500 2900
3500	3500	3000	3100	3200	2600	2000 1600 1500 1700
1500	1200	1000	1000	1100	1200	1300 1300 1300 1300
1400	1600	1800	2000	2200	2300	2300 2400 2300 2100
2500	2700	2600	2400	2300	2000	2000 2300 2500 2700
3200	3600	3400	3200	2600	2000	1700 1600 1900 2000
1800	1300	1100	1000	1000	1100	1200 1200 1200 1300
1400	1600	1900	2000	2100	2200	2400 2600 2600 2500
2800	2800	2700	2500	2400	2200	2100 2300 2500 2700
3000	3500	3400	2800	2100	1700	1700 1900 2300 2300

Example of part of a block of 1x2 minute terrain file

1 2 3 4 5  
 123456789012345678901234567890123456789012345

```

DM1MRDU895F2 60 0 160 033 03/00/91 MERGED
 846 631 800 631 387 358 415 461 486 604
 781 831 1019 853 939 451 752 993 878 659
 861 404 314 656 319 329 292 287 262 423
 722 627 937 914 509 343 394 432 600 602
 522 832 954 775 1017 448 697 907 653 520
 739 371 188 426 232 510 709 696 591 665
 825 693 867 711 705 474 333 413 573 825
 739 541 598 800 701 299 484 558 650 583
 538 434 566 201 121 131 290 608 706 606
 979 1020 958 1055 913 583 526 575 775 994
1160 757 843 1042 369 457 644 695 489 558
 615 833 806 306 487 137 111 256 240 321
 844 697 891 922 940 710 535 525 586 882
1133 1071 1061 799 337 405 869 480 377 587
 861 1050 740 442 670 480 229 98 140 243
 712 655 889 797 917 861 552 498 406 512
 655 1022 972 464 354 753 810 341 600 813
 995 727 699 458 767 757 612 173 93 94
 645 711 815 622 687 616 521 504 415 333
 347 455 436 340 609 982 491 500 773 662
 632 380 268 276 431 533 332 115 97 99
 555 783 676 587 561 542 539 524 479 374
 289 330 389 508 802 592 362 804 1001 984
 615 286 295 175 157 188 106 166 362 168
 496 684 654 580 564 567 569 584 606 512
 309 282 484 722 925 330 431 878 1037 926
 770 606 731 489 457 256 352 330 445 184
 362 441 464 549 584 591 597 603 585 447
 399 289 279 495 554 316 435 520 543 567
 646 832 951 702 1050 756 649 417 507 380
 349 355 367 491 586 605 629 636 572 522
 603 447 303 268 321 429 800 825 843 728
 784 797 1042 927 1133 928 613 621 563 483
 359 352 359 449 592 632 603 731 722 579
 594 532 477 412 293 710 698 685 991 1057
 755 873 1076 1110 1036 613 463 311 425 612
 415 380 361 372 434 502 512 599 635 631
 682 503 543 487 415 706 613 849 791 658
 672 718 898 757 816 747 544 388 137 139
 506 448 481 479 463 360 411 548 580 535
 443 401 322 269 388 458 567 603 490 616
 980 759 942 681 344 273 276 128 124 221
 562 541 560 610 796 490 361 463 578 633
 471 573 475 153 233 122 119 178 267 415
  
```

Example of a 3x6 minute terrain file

1 2 3 4 5  
 1234567890123456789012345678901234567890123456789012345

```

DM3MRDU895F2 60 0 160 033 03/00/91 MERGED
772 559 456 697 851 621 676 396 326 538
453 215 144 104 101 98 96 182 134 120
849 855 553 910 693 606 655 673 472 184
177 99 117 159 158 143 124 118 105 108
669 592 527 359 579 597 822 390 312 218
271 304 335 342 271 373 179 148 115 123
379 564 631 490 378 602 768 923 805 480
333 211 204 323 181 267 195 171 156 169
473 501 521 541 365 468 616 808 492 257
235 265 115 80 137 154 159 165 183 225
586 808 591 605 189 470 539 557 405 232
249 142 295 261 109 122 123 125 161 234
470 596 549 367 247 463 691 438 267 431
292 83 32 76 75 92 100 101 131 333
303 386 475 203 374 440 671 408 260 375
518 323 67 30 32 57 80 86 111 176
357 274 196 94 391 309 338 359 216 54
106 22 15 15 26 55 71 72 68 105
273 143 77 259 338 329 370 170 103 170
215 296 129 45 51 62 54 59 50 56
159 164 94 456 420 403 388 387 304 174
62 52 52 30 56 80 65 92 52 42
113 115 106 406 369 445 427 403 218 151
49 106 145 86 34 75 153 137 71 39
52 58 192 321 307 300 486 349 167 225
145 139 190 260 70 68 253 265 146 60
89 115 490 459 382 367 491 279 235 89
82 45 22 97 91 53 335 240 214 151
79 183 453 314 362 315 323 267 217 296
70 198 106 21 127 51 96 141 199 150
183 348 386 170 250 213 120 250 111 350
160 153 196 69 20 25 49 85 125 111
229 281 252 178 301 230 101 241 285 123
44 63 124 64 17 12 38 50 86 82
261 205 193 210 306 194 110 91 144 108
67 26 37 44 22 7 29 29 51 63
98 82 118 409 165 108 239 97 45 41
8 11 4 22 33 11 10 11 29 47
99 203 201 240 58 187 221 71 10 33
99 4 3 13 20 2 1 3 10 33
  
```