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

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°x1° 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 3x6 second data, contain $\frac{1}{4}$x$\frac{1}{2}$, 1x2, and 3x6 minute terrain digitization. Each $\frac{1}{4}$x$\frac{1}{2}$ minute compartment contains 25 3x6 second compartments. Each 1x2 minute compartments contain 400 3x6 second compartments and each 3x6 minute compartment contains 3600 3x6 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 $\frac{1}{4}$x$\frac{1}{2}$ 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.

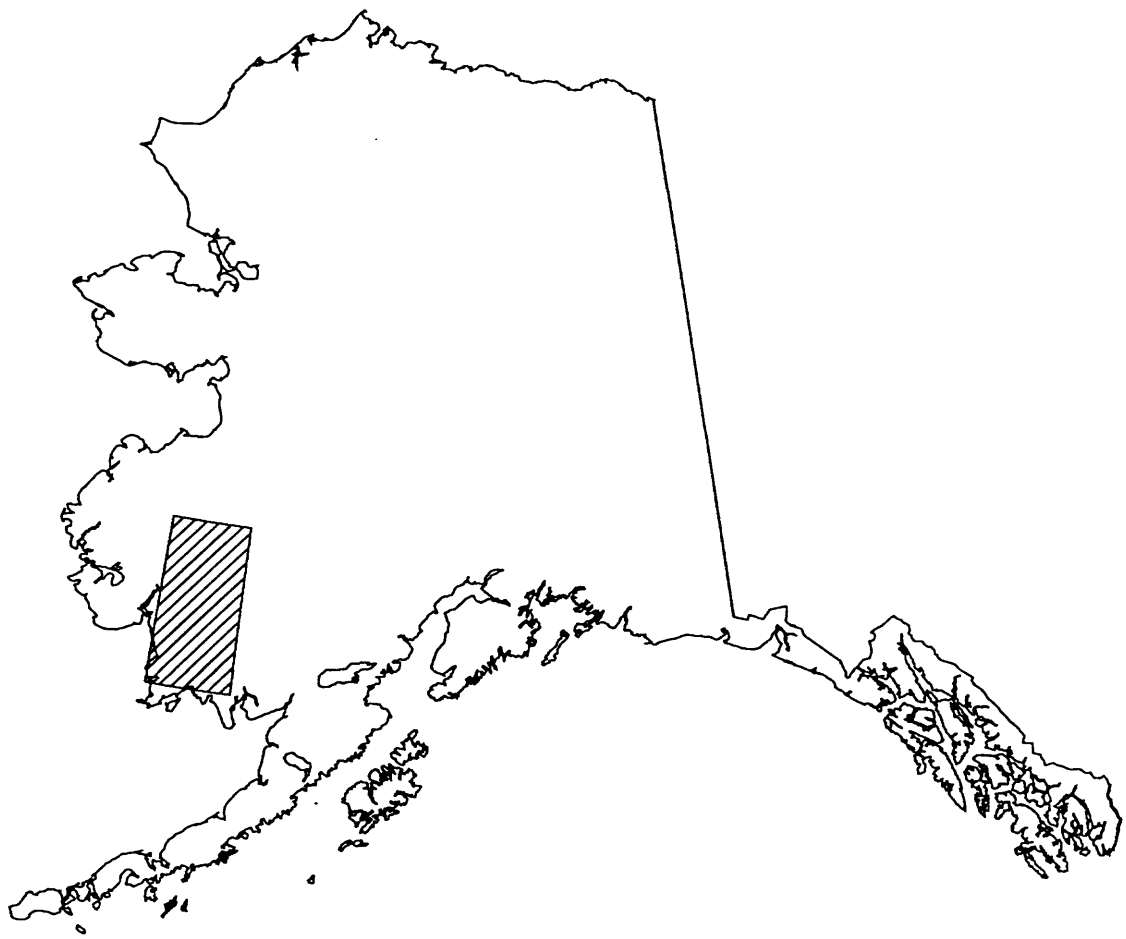

FIGURE 1. –Location of study area. Shown are the boundaries of Russian Mission, Bethel, and Goodnews Bay 1°x3° quadrangles, Alaska.

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 $\frac{1}{4}$x$\frac{1}{2}$ 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 prexisting 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 $\frac{1}{4}$x$\frac{1}{2}$ minute, 1x2 minute, and 3x6 minute terrain for the Russian Mission, Bethel, and Goodnews Bay 1:250,000 scale quadrangles. The $\frac{1}{4}$x$\frac{1}{2}$ 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.

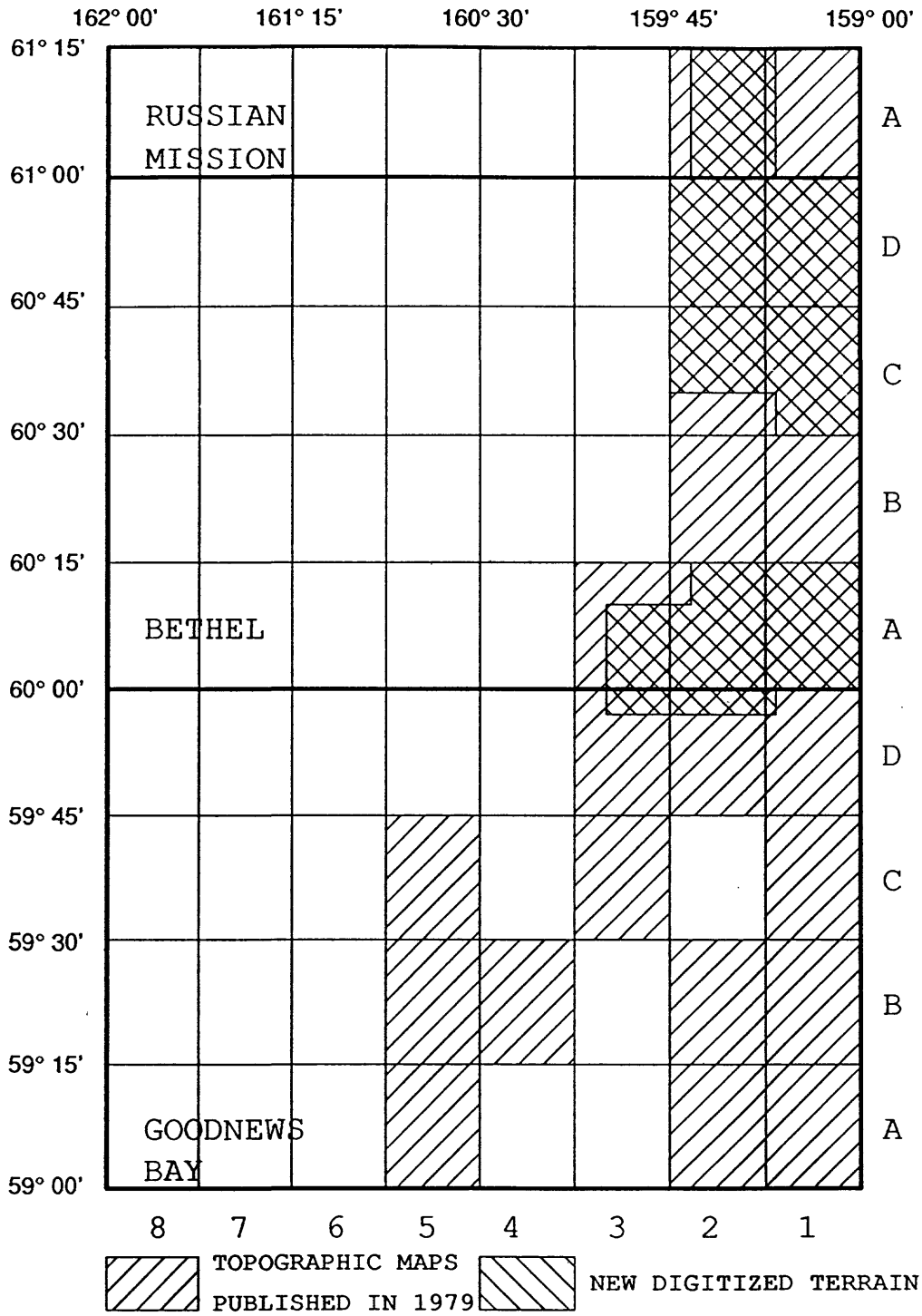

FIGURE 2. –Index map of 1:63,360 scale topographic maps published in 1979 in the Bethel, Russian Mission, and Goodnews Bay 1°x3° quadrangles, Alaska which were not available when the digital elevation files were produced. Also shown is the area of updated $\frac{1}{4}$x$\frac{1}{2}$ minute terrain.

READING DISKETTES

The data described in this report are available as Open-File Report 93-702-B. These data are on two $3\frac{1}{2}$-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
12345678901234567890123456789012345678901234567890123456789012345

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
12345678901234567890123456789012345678901234567890123456789012345


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
12345678901234567890123456789012345678901234567890123456789012345


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
```