README FILE FOR MODFLOW-96 WITH LINK-MT3D INTERFACE

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GENERAL INFORMATION

This ReadMe file documents a modified version of MODFLOW-96 with the Link-MT3D (LMT) Package Version 5.0. The original files for MODFLOW-96 were dated May 2000 and downloaded from the USGS ground-water software web site http://water.usgs.gov/nrp/gwsoftware/. For more information on the standard USGS version of MODFLOW-96, refer to the ReadMe file MODFLW96.TXT.

The version of MODFLOW-96 included with MT3DMS is identical to the standard USGS version as downloaded except for the following additions:

1) the LMT package for saving the flow-transport like file needed by the MT3D/MT3DMS series of transport codes;
2) dynamic memory allocation;
3) printing of iterative solver statistics to the computer screen.

IMPLEMENTING THE LINK-MT3D PACKAGE

The version of MODFLOW-96 distributed with MT3DMS has already included the Link-MT3D package. If you are interested in implementing the LMT package on your own version of MODFLOW-96, follow the procedures described below:

1) Assign the character string 'LMT' to the 22nd element of the CUNIT array by modifying the DATA statement in the MODFLOW-96 main program as follows:

```
C...beginning of DATA statement
      DATA CUNIT/'BCF ','WEL ','DRN ','RIV ','EVT ','TLK ','GHB ',
     1           'RCH ','SIP ','DE4 ','SOR ','OC  ','PCG ','GFD ',
     2           '    ','HFB ','RES ','STR ','IBS ','CHD ','FHB ',
     3           'LMT ','    ','    ','    ','    ','    ','    ',
     4           '    ','    ','    ','    ','    ','    ','    ',
     5           '    ','    ','    ','    ','    '/
C...end of DATA statement
```

2) Add an INCLUDE statement to the main program immediately before the 'CALL BAS5OT(...)' statement as follows:

```
C...added...beginning...
C-----SAVE INFORMATION FOR USE BY THE MT3D SOLUTE TRANSPORT MODEL
      INCLUDE 'M96LKMT5.INC'
C...added...end...
C
C-----PRINT AND OR SAVE HEADS AND DRAWDOWNS. PRINT OVERALL BUDGET.
      CALL BAS5OT(X(LCHNEW),X(LCSTRT),ISTRT,X(LCBUFF),X(LCIOFL),
```

and

3) Recompile the MODFLOW-96 source files with the include file **'M96LKMT5.INC'** and a second source file **'M96LKMT5.FOR'**. Make sure that these two files are in the same working directory with all other MODFLOW-96 source files.

USING THE LINK-MT3D PACKAGE

To activate the LMT Package 5.0 to save the flow-transport file needed by MT3D/MT3DMS, insert a line (shown in capital letters) into the MODFLOW-96 NAME file as in the following example.

An example of MODFLOW-96 NAME file:

```
list  6  test1.lst
bas   1  test1.bas
bcf  11  test1.bcf
sip  13  test1.sip
oc   14  test1.oc
LMT  32  TEST1.FTL
data(binary) 93 test1.ufh
```

where LMT is the name of the Link-MT3D package, integer 32 is the FORTRAN unit on which the flow-transport link file will be saved, and TEST1.FTL is the name of the flow-transport link file containing the flow model information needed by MT3D/MT3DMS. The unit for LMT can be any positive integer as long as it has not been used for any other files. Any valid file name can be specified by the user for the flow-transport link file. When running MT3D/MT3DMS and prompted for the name of the flow-transport link file, make sure to enter the same file name, e.g., TEST1.FTL in this example.

A NOTE ON THE UNFORMATTED FLOW-TRANSPORT LINK FILE

Note that the flow-transport link file saved by the LMT Package 5.0 is unformatted (binary characters). Different FORTRAN compilers or even different versions of the same compiler may use different file structures and styles for the unformatted binary files. For this reason, the MT3D/MT3DMS code compiled by a particular compiler may not be able to read the unformatted flow-transport link file saved by a MODFLOW code that was compiled with a different compiler or compiler version, and vice versa.

This version of MODFLOW-96 was compiled by Lahey Fortran 95 compiler (LF95). The style of unformatted files generated by LF95-compiled programs is compatible

with that of Visual Fortran (VF) from Compaq/HP, but not compatible with that of Lahey Fortran 90 compiler (LF90) used for compiling MT3D/MT3DMS prior to Version 4.5. Thus, it may be necessary to re-run an existing flow model using this version of MODFLOW-96 to create the flow-transport link file for use by MT3DMS 4.5. Also, several utility programs included with the MT3DMS 4.5 distribution files may be used to convert an unformatted flow-transport link file from the LF90-style to LF95/VF-style, and vice versa. For more information, refer to the ReadMe file for MT3DMS 4.5 utilities (Utilities.PDF).

SYSTEM REQUIREMENTS AND DYNAMIC MEMORY ALLOCATION

The executable program, mf96.exe, was compiled with the Lahey FORTRAN 95 compiler LF95 Version 5.70 to run on PCs equipped with Pentium or higher CPUs under various versions of the Microsoft Windows operating system. The executable program was compiled with dynamic memory allocation and will allocate the exact amount of memory that is required for a particular problem at run-time. If the memory required by the problem exceeds the total amount of physical memory that is available, mf96.exe will print out a message "NOT ENOUGH MEMORY" and then aborts. mf96.exe is a console mode application under Microsoft Windows 9x/2000/NT/XP.

INSTALLATION AND RECOMPILING

The executable code for this version of MODFLOW-96 has been included as part of the MT3DMS 4.5 distribution files. If the source code is recompiled, copy the recompiled executable file to the subdirectory where the MT3D/MT3DMS executable files are located.

To use the MODFLOW-96 program independently, create a subdirectory with a name such as ‘MF96LMT\bin’ and copy the file ‘mf96.exe’ to the new subdirectory. To make the MODFLOW-96 program accessible from any directory, the subdirectory containing the executable should be included in the PATH environment variable. For example, a line similar to the following can be added to the AUTOEXEC.BAT or AUTOEXEC.NT file:

```
PATH=%PATH%;C:\MF96LMT\bin
```

Make sure to substitute the appropriate drive letter and pathname if not C:\ as shown above. Reboot the computer after modifying AUTOEXEC.BAT.

On Windows 9x/2000/NT/XP operating systems, from the Start menu, find and select Control Panel. Then edit the PATH Environment Variable to include “C:\MF96LMT\bin". Initiate and use a new MS-DOS Command Prompt window after making this change.

To re-compile this version MODFLOW-96 with Lahey LF95, copy all source files to a temporary subdirectory and type 'AM' to start the AUTOMAKE utility. The compiler options that should be used for recompiling are contained in the file Automake.fig.

ADD-ON PACKAGES

This version of MODFLOW-96 contains the following add-on packages

Package NAME	CUNIT/IUNUT Position	Supported by MT3D
TLK	6	No
DE4	10	n/a
PCG	15	n/a
GFD	14	No
HFB	16	Yes
RES	17	No
STR	18	Yes
IBS	19	No
CHD	20	Yes
FHB	21	No
LMT	**22**	**Link-MT3D Interface**

To use any of these packages, insert a corresponding line
in the MODFLOW NAME file in the form of

Ftype Nunit Fname

where Ftype is the predefined name of the Package;
Nunit is the FORTRAN unit to be used when reading from or writing to the file;
and Fname is the name of the file. For example, to use the PCG package,
enter a line such as

PCG 13 Test1.PCG

where Test1.PCG is the name of the input file for the PCG package.

LIST OF FILES

This version is distributed with the following files:

README_MF96LMT.txt: latest readme file (this file)
MODFLW96.txt: original readme file included with the USGS version
MF96_User_Guide.PDF: MODFLOW-96 User's Guide
MF96_Programmer_Guide.PDF: MODFLOW-96 Programmer's Guide

mf96.exe: executable program for PCs with Pentium or higher CPUs
m96lkmt5.for: source file for LinK-MT3D package (for linking with MT3DM
m96lkmt5.inc: source "include file" used by MAIN to invoke Link-MT3D package
modflw96.for: source file for MAIN program
bas5.for: source file for Basic package
bcf5.for: source file for Block-Centered Flow package
drn5.for: source file for Drain package
evt5.for: source file for Evapotranspiration package
rch5.for: source file for Recharge package
riv5.for: source file for River package
sip5.for: source file for Strongly Implicit Procedure package

```
    sor5.for: source file for Slice Successive Over-Relaxation package
    wel5.for: source file for Well package
    ghb5.for: source file for General Head Boundary package
    utl5.for: source file for Utility package
    pcg2.for: source file for Preconditioned Conjugate Gradient Package
    str1.for: source file for Stream Package
    gfd1.for: source file for General Finite Difference Flow Package
    hfb1.for: source file for Horizontal Flow Barrier Package
    ibs1.for: source file for Interbed-Storage Package
    chd1.for: source file for Time-Variant Specified-Head Package
    tlk1.for: source file for Transient Leakage Package
    de45.for: source file for Direct solver
    res1.for: source file for Reservoir Package
    fhb1.for: source file for Flow and Head Boundary package
automake.fig: lf95 configuration for the Automake utility
```