

SUPPLEMENTARY WHAFIS DOCUMENTATION

WHAFIS 4.0

A Revision of FEMA's WHAFIS 3.0 Program

Version 4.0G August 10, 2007

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1. *Background Discussion*

FEMA's overland wave propagation program WHAFIS (previously Version 3.0) has been revised for two major reasons:

- As part of the Pacific Coast Guidelines development, it was determined that WHAFIS should be generalized for Pacific applications to permit the use of arbitrary wind speeds. WHAFIS 3.0 incorporates default wind speeds that are representative of 100-year hurricane conditions on the Atlantic and Gulf coasts, but which are not appropriate for most Pacific coast applications. The default WHAFIS 3.0 wind speeds are not accessible to the user, but are hardwired into the program code. Consequently, a generalized version of WHAFIS for Pacific applications was developed, called PWHAFIS (Pacific WHAFIS), allowing the user to override the default speeds.
- More recently, as part of the 500-year guidelines development for the Atlantic and Gulf coasts, it was determined that WHAFIS should be revised again, incorporating default wind speeds appropriate for 500-year conditions in addition to the 100-year wind speeds used in WHAFIS3.

WHAFIS 4.0 is an updated version incorporating both of these changes, as well as certain other refinements, bug-fixes, and improved input and output documentation.

WHAFIS 4.0 has been designed so that by default it is transparently compatible with all old analyses that were made using WHAFIS3. That is, any WHAFIS3 input file should run under WHAFIS 4.0 without any modification, and should produce identical numerical output (but see a later notes for a discussion of differences in output format and precision). This supplementary documentation specifies how the revised program is used in its new non-default modes allowing the user to choose 500-year winds rather than 100-year winds, or to specify entirely arbitrary wind speeds. It also summarizes new features such as the provision for two types of comment cards in the input file.

A working knowledge of WHAFIS3 is assumed throughout this brief supplement. If the user is not familiar with any particular aspect of WHAFIS3, Appendix D of FEMA’s Guidelines and Specifications should be consulted. Those coastal study guidelines give a thorough overview of WHAFIS and describe the use of each card type, the exact contents of each card field, and so forth.

2. Default Wind Speeds

WHAFIS internal computations involve three wind speeds. In WHAFIS3, the 100-year wind speed that is used at an open over-water fetch (OF card) is taken to be 80 mph. If the user does not enter incident wave characteristics on the IE card (incident wave height and/or wave period), WHAFIS computes default starting wave conditions using the OF windspeed. Similarly, in WHAFIS3, the reduced windspeed used over an inland fetch (IF card) is set to 60 mph, and the speed imposed for marsh grass computations (VH/MG cards) is also set to 60 mph. WHAFIS does not use wind speed or wind-driven wave regeneration for other transect segments such as those modeled with VE and BU cards.

Default wind speeds for 500-year conditions were selected as part of the 500-year Guidelines update. These new speeds are 100 mph for OF reaches (and incident wave calculations), 75 mph for IF reaches, and 75 mph for VH/MG reaches. In each case, the 500-year wind is 25% greater than the 100-year wind.

3. Selecting 500-year Conditions

Unless steps are taken to override its normal behavior, WHAFIS 4.0 mimics WHAFIS3. In order to perform a 500-year analysis using the new wind speed defaults, the user must include the key string “:500:” (without the quotation marks) at the beginning of the transect’s Title card. If this string is not found, a normal 100-year computation will be made. No special key string is required for a 100-year case.

Title Line Examples:

Transect XYZ
:500: Transect XYZ

This title card gives a 100-year case
This title card forces a 500-year case

4. Selecting Non-Default Wind Speeds

WHAFIS3 does not use Fields 8, 9, and 10 of the IE card. WHAFIS 4.0 has been written to use those fields in order to specify non-default wind speeds.

One enters wind data as follows:

IE Card, Field 8 (columns 57-64): Enter the windspeed, in MPH, to be used for IF reaches. If this field is blank or zero, the default IF windspeed will be used (60 mph for a 100-year simulation, or 75 mph if the :500: key string was found at the beginning of the Title card).

IE Card, Field 9 (columns 65-72): Enter the windspeed, in MPH, to be used for OF reaches. This value will also be used to compute the incident wave conditions, if necessary. If this field is blank or zero, the 100 or 500-year default will be used (80 or 100 mph, respectively).

IE Card, Field 10 (columns 73-80): Enter the windspeed, in MPH, to be used for VH/MG reaches. If this field is blank or zero, the 100 or 500-year default will be used (60 or 75 mph).

Guidance is not provided here for the selection of appropriate non-default wind speeds. The user should carefully evaluate realistic speeds for any given application, and should confer with the appropriate FEMA Project Officer to obtain concurrence with final selections.

5. Input File Annotation — CM Cards

A new feature of WHAFIS 4.0 is provision for the use of comment cards within the input file, with the new card type “CM.” At any point within the input file — after the IE card and before the ET card — the user may insert one or more CM cards (up to a maximum of 100 such cards per file). The contents of a CM card (columns 3-80) can be freely used to insert any notes of interest for file annotation. Possible uses, for example, might be to explain any non-standard assumptions made for the data entered on an adjacent card, or to insert temporary reminders or bookmarks. Note: the same use can be made of columns beyond column 80 on any card; CM cards are allowed for greater clarity.

CM cards are ignored by the program.

6. Input File Annotation — PS Cards

A new feature closely related to the CM card is provision for the use of postscript cards within the input file, with the new card type “PS.” These are the same as CM cards with the sole exception that the contents of the PS cards are stored as the input file is read, and are printed at the end of the output file in a new section, Part 7. Any number of PS cards, up to 100, may be inserted anywhere within the input file after the IE card and before the ET card. They are sequentially numbered and printed verbatim to Part 7 of the output file.

PS cards should be used instead of CM cards whenever a comment could be important for later interpretation of the output. Another use which has been suggested for PS cards is to record GIS information describing the transect, such as the coordinates of starting and ending points, or a

starting coordinate and a heading. The user might adopt a convention to embed such information in the PS cards in such a way that a separate utility program could parse the output file and automatically extract the needed values. For example, the strings XZERO and YZERO might be reserved for specification of state plane coordinates of the initial transect point, and an input file might include the lines:

```
PS XZERO = 12345.67
PS YZERO = 34567.89
```

These would be echoed in Part 7 of the output, and could be extracted for use by another program.

7. Command Line Usage and the Help Screen

Normal usage of WHAFIS 4.0 is from the command line, with input and output file names provided as command line parameters, as in the following example:

```
WHAFIS4 inputFileName outputFileName
```

Note that WHAFIS4.EXE, as currently distributed, is a Windows 32 Bit Console-mode program. This means that Windows 32 long filenames may be used, rather than just 8.3-format DOS file names as used in prior versions.

If the user does not specify input and output file names, the program will prompt for them. At the prompt, simply enter the appropriate filename followed by <RETURN>.

If names are not entered properly, if the input file cannot be found, or if a parameter such as ? or /H is entered, the program will display a simple help screen to remind the user of the proper mode of operation.

8. Changes in the Output File Format

Several minor modifications of the output file format have been made, including the following:

- The date and time of execution are shown near the top of the output file.
- The full pathnames of the input and output files are shown near the top of the output file.
- After the transect title (just ahead of Part 1), a note is printed stating whether the case is a 100 or a 500-year simulation.
- If non-default windspeeds are used, this is also noted — and the adopted speeds are displayed — just ahead of Part 1 of the output.

- Wherever the WHAFIS3 output indicated that an item was a 100-year result, WHAFIS 4.0 now indicates 500-year results, if appropriate.
- Part 7 of the output file is new, and echoes the PS cards encountered in the input file.

9. Miscellaneous WHAFIS 4.0 Notes

- Since a blank or zero wind speed entry on the IE card reverts to the corresponding default, an entry of zero cannot be used to force the use of zero speed. Instead, the user should enter a small value, such as 0.01 mph, which would be adopted in the calculations and which would adequately approximate a zero speed.
- The OF speed — WINDOF — is also used to compute the initial (incident) wave height and/or period if they are not explicitly specified on the IE card.
- The only known quantitative difference between the behavior of WHAFIS 3.0 and WHAFIS 4.0, in its default mode, is that rounding of station values is done somewhat differently. Consequently, small differences might be found if new calculations made with WHAFIS 4.0 are compared with older output files.
- Where station values had previously been rounded to whole feet, they are now rounded to the tenth of a foot. ***Despite this change, it is recommended that successive stations should not commonly be separated by less than one foot.*** This change allows the program to run without failing if, for some reason, the user insists upon a spacing of less than a foot. Note that the use of automatic GIS tools may produce files with very closely spaced stations under some circumstances. It is recommended that these should be edited to reflect a more honest understanding of the profile.
- A minor output format difference is that WHAFIS 3.0 sometimes printed numbers between zero and one without a leading zero; as .123, for example. WHAFIS 4.0 will print such a number as 0.123, which is the preferred form.
- There is a minor irregularity in the WHAFIS3 output which has been preserved in the revision, and which might lead to a misinterpretation of the output. Part 1 of the output file purports to echo the input, but it doesn't quite do so. Instead, Field 9 of all cards is overwritten in the output file to show a computed ground slope that is not part of the input. This behavior has *not* been changed in WHAFIS 4.0. Consequently, a non-default value of WINDOF, which would otherwise be displayed in Field 9, is overwritten in Part 1 of the output, while non-default values of WINDOF and WINDVH, if used, will be shown correctly in Fields 8 and 10. In order to verify that all three values have in fact been properly read or defaulted, WHAFIS4.0 prints the three wind speeds ahead of Part 1 of the output file, just after a new notice that non-standard values are being used. However, this message does *not* appear if all three speeds equal their defaults; the lack of

such a diagnostic message indicates that all standard defaults have been adopted, whether 100 or 500-year.

- Parts 5 and 6 of the output file refer to A and V zones. This has not been altered in WHAFIS 4.0, although the user should be aware that strictly speaking, these terms refer only to 100-year computations, and not to 500-year computations. That is, an AE or a VE zone is a 100-year concept by definition. In the case of a 500-year simulation, these identifiers should be interpreted simply to mean areas for which the wave height is less than or greater than 3.0 feet.
- The external (and internal) timestamps of WHAFIS4.EXE — if not altered — indicate the program's version number. For example, release 4.0G is identified by a timestamp of 4:07. A future modification to version 4.0H will show a timestamp of 4:08.