

**CANADA WIDE STANDARD FOR PETROLEUM
HYDROCARBONS (PHC) IN SOIL**

**SPREADSHEET MODEL:
USER DOCUMENTATION**

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Under contract to:
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1.0 INTRODUCTION

1.1 General

This spreadsheet has been prepared in support of the Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil (PHC CWS). It is designed to be used in conjunction with the PHC CWS and supporting documentation, particularly the PHC CWS User Guidance. It is strongly recommended that users be familiar with the User Guidance, and consult it during spreadsheet operation.

The spreadsheet assists users with the implementation of Tier 1 and Tier 2 of the PHC CWS. Specifically, it presents the governing Tier 1 risk management objectives for a site based on a scenario defined by the user, and calculates optional Tier 2 risk management objectives based on user-supplied site-specific parameters.

A conceptual model of the spreadsheet's structure and operation is shown on Figure 1.

The spreadsheet was designed to operate using Microsoft® Excel 97 or later. It may be possible to operate the spreadsheet using other spreadsheet software packages, but some features may not function.

The spreadsheet model may be revised or updated from time to time; the user should ensure he or she is using the current version of the spreadsheet. The version number of the spreadsheet is displayed in the top right corner of the Tier 1 worksheet and the Tier 2 output worksheet. At present, the spreadsheet is limited to the calculation of risk management objectives for PHC fractions F1 through F4.

1.2 What the Spreadsheet Is and Isn't

This spreadsheet is a tool to assist with the application of Tier 1 and Tier 2 management under the PHC CWS. The spreadsheet uses mathematical models specified in the Scientific Rationale and User Guidance for the PHC CWS.

The spreadsheet is not meant to replace knowledge and understanding of the PHC CWS and the User Guidance. It also does not relax the level of technical expertise required to conduct site investigations or implement Tier 1 or Tier 2 management.

Tier 2 adjustments of any model parameters require sufficient supporting data to justify the value selected (in the case of soil parameters, this normally means more than one measurement, and may require repeat measurements over a period of time for some parameters).

1.3 *Basic Instructions*

Prior to using the spreadsheet, the user should ensure that sheet tabs and automatic calculations are enabled in Excel (done through the Tools→Options menu). Also, the ***Analysis ToolPak add-in must be installed and loaded*** (through the Tools→Add-Ins menu).

The spreadsheet comprises the following worksheets:

1. **Home:** Title page.
2. **Instructions:** Spreadsheet instructions.
3. **Tier1:** The Tier 1 sheet, used to define the Tier 1 scenario, display governing Tier 1 objectives, and provide comments relating to the Tier 1 decision.
4. **T2_Input:** The Tier 2 input sheet, used to refine the Tier 2 scenario and enter site-specific values for user-adjustable parameters. This worksheet also holds the default values for the user-adjustable parameters.
5. **T2_Fixed:** This worksheet holds model parameters which cannot be adjusted by the user at Tier 2 (receptor characteristics and chemical properties), as well as a few calculated parameters.
6. **T1_Lookup:** This is a look-up table with all of the Tier 1 values. It is used by the Tier 1 sheet.
7. **Calculations:** This is the calculation module, with all the models implemented as described in the Scientific Rationale and User Guidance.
8. **T2_Output:** The Tier 2 output sheet, which displays the results of Tier 2 adjustments, along with all input parameters, and provides comments relating to the Tier 2 decision.

The spreadsheet is designed to be used by systematically proceeding through the user input worksheets. There are two user input worksheets, labelled **Tier1** and **T2_Input**.

A section has been included at the top of the Tier 1 sheet for the user to enter general project information (user name, proponent, date, site, file number and comments). This information is also carried forward to the Tier 2 output sheet.

Both of the user input worksheets include a series of input cells. A reference number is listed to the immediate right of each input cell; the reference numbers will be used to identify input cells within this documentation. In some places reference to a section of the User Guidance is provided.

A series of hyperlinks have been added to the spreadsheet to assist the user with navigation between different sections and worksheets.

Input cells #1 through #25 require simple text input. These cells are case insensitive, and only the first letter of the input is used. So, for example, a user wishing to specify a residential land use in cell #1 could input “R”, “r”, “Res” or “residential”, all of which would yield the same result. The remaining input cells accept numerical input. All non-input cells are locked to prevent inadvertent modification of the spreadsheet.

Some entries will result in a comment appearing next to the input cell. In some cases, this is because the value entered is invalid. In others, it reflects a potential restriction with the selection of that option (for example, using subsoil values at Tier 1).

Detailed instructions regarding the use of the two input worksheets are provided in sections 2.0 and 3.0 below.

1.4 Abbreviations

The following abbreviations are used in various places in the spreadsheet:

A	– agricultural land use
C	– commercial land use
cg	– coarse-grained soil
F1	– PHC fraction 1 ($C_6 - C_{10}$)
F2	– PHC fraction 2 ($C_{>10} - C_{16}$)
F3	– PHC fraction 3 ($C_{>16} - C_{34}$)
F4	– PHC fraction 4 ($C_{>34}$)
FAL	– freshwater aquatic life
fg	– fine-grained soil
GW	– groundwater
I	– industrial land use
N	– no
NA	– not applicable or calculated objective exceeds 1,000,000 mg/kg
PHC	– petroleum hydrocarbons
R	– residential land use
RES	– calculated objective exceeds 30,000 mg/kg or residual solubility limit
Y	– yes

2.0 TIER 1 GUIDANCE

2.1 Defining the Scenario

Determination of the governing Tier 1 objectives for a site is done using the **Tier1** worksheet.

The governing Tier 1 objectives are based on the scenario for the site. The scenario is defined in cells #1 through #7. It is important that each of the questions in these cells be answered. The user should ensure that all information necessary to define the scenario is collected during the site assessment.

Cells #1 and #2 are used to establish the land use classification of the site and the soil type. The determination of the land use is detailed in Section 2.1.2 of the User Guidance; the user must consider not only the current land use, but zoning/future land use and the surrounding land uses (setback distances may be specified by jurisdictions).

The definition of a municipal zoning should be compared to the descriptions of land uses in the User Guidance; zoning designations may not necessarily correspond exactly with CCME land use designations with similar names. For example, in some municipalities there are types of commercial zonings which allow residences to be built on the property; in this case the residential land use would apply. Section 2.1.3 of the User Guidance should be consulted to determine the predominant soil type in the zone of contamination (coarse-grained or fine-grained); if the soil type is uncertain, coarse-grained should be specified.

The soil type is refined in cells #3 and #4. The purpose of these cells is to determine whether soil layers other than the predominant soil type in the zone of contamination require modification of the Tier 1 objectives, as detailed in Section 2.1.3 of the User Guidance. For example, a coarse-grained soil layer in the saturated zone may govern groundwater transport, and a coarse-grained soil layer near grade may govern vapour migration into a building. The protection of potable groundwater pathway may be governed by a fine-grained layer above the saturated zone (limiting groundwater recharge) or in the saturated zone (limiting dispersion of the contamination).

Cells #5 and #6 are used to define the potential water use at the site (Section 2.1.2 of the User Guidance). For potable water use, both current use and potential future use must be considered.

Cell #7 allows the user to generate Tier 1 objectives for subsoils (>1.5 m below grade) instead of surface soils. Application of these values may lead to land use restrictions or may not be permitted at Tier 1 in some jurisdictions. The use of subsoil values is detailed in Section 3.2.4 of the User Guidance.

2.2 Applicability of the Generic Approach

As described in Section 2.2.2 of the User Guidance, Tier 1 can only be applied if the land and water use is encompassed by one or more of the generic land use categories, and no conditions exist which are significantly more sensitive or critical than those assumed in the derivation of the Tier 1 values. Detailed information relating to the assumptions underlying the Tier 1 values is available in the PHC CWS Scientific Rationale.

Cells #10 through #15 are designed to identify potential conditions which may result in the generic (Tier 1 and possibly Tier 2) approach being inapplicable. The list of questions in this section is not comprehensive; it is the responsibility of the proponent to identify any conditions which may lead to requirements for a Tier 2 or Tier 3 assessment.

These cells do not in any way affect the Tier 1 or Tier 2 numbers generated by the spreadsheet; they are present only to help the user determine whether the generic (Tier 1 or Tier 2) approach is applicable.

2.3 Results of Tier 1

The governing Tier 1 objectives for the defined scenario are presented immediately below the input cells in a table titled “Governing Tier 1 Objectives”. The table includes not only the governing objective for each PHC fraction, but also the governing exposure pathway.

The Tier 1 objectives by pathway are presented in a separate table below for reference purposes.

2.4 Tier 1 Decision

A hyperlink located near the “Governing Tier 1 Objectives Table” (in cell J40) leads to the Tier 1 Decision section of the spreadsheet. This section can also be found by scrolling down the Tier 1 sheet.

Reference should be made to Section 2.3 of the User Guidance. The spreadsheet provides qualitative information on the potential for Tier 2 modification, based on the governing pathway for each fraction. If the governing pathway is based on equations which have easily adjustable parameters (i.e. vapour inhalation or any groundwater protection pathway), the potential is defined as “good”. The potential for Tier 2 modification is defined as “limited” for the ecological soil contact pathway; this pathway can only be modified by exclusion or by use of subsoil values. The potential for Tier 2 modification is defined as “negligible” for pathways which can only be modified by changing the PHC composition at Tier 2 (i.e. soil ingestion and dermal contact).

At this point, the user can decide to apply Tier 1 for the site; in that case, the Tier 1 sheet can be printed and appended to a report. Alternatively, the user can decide to proceed to Tier 2 by either clicking on the hyperlink or selecting the **T2_Input** worksheet. The user can also decide to proceed to Tier 3, which is beyond the scope of this spreadsheet.

3.0 TIER 2 GUIDANCE

3.1 Defining the Scenario

Tier 2 adjustments are performed using the **T2_Input** worksheet. The land use, soil type and water use defined in the Tier 1 worksheet are carried forward to Tier 2 and displayed at the top of the Tier 2 input sheet; therefore, the user must complete the Tier 1 sheet prior to beginning Tier 2.

Cells #21 through #25 allow for further refinement of the scenario by eliminating certain pathways or applying subsoil values for ecological soil contact. Section 3.2.4 of the User Guidance should be consulted prior to using these cells. Elimination of pathways or use of subsoil values for ecological soil contact will normally result in land use restrictions,

and may not be allowed at Tier 2 in some jurisdictions. These cells should be left blank if they are not being used.

Specifically, cells #21 and #22 allow for the elimination of the direct contact and ecological soil contact pathways, and cell #23 specifies the use of subsoil values for ecological soil contact. These options may be allowed in situations where a site is completely paved or capped, or to calculate Tier 2 objectives for subsoil contamination. Land use restrictions would normally apply, and elimination of the ecological soil contact pathway may not be allowed by the jurisdiction.

Cell #24 relates to the vapour inhalation pathway. Normally, a slab-on-grade building is used for commercial and industrial scenarios and the more conservative of a slab-on-grade building or a building with a basement is used for agricultural and residential scenarios (in most cases, but not always, the slab-on-grade building is more conservative). This cell allows the user to specify one type of building or the other. If a basement is specified for a commercial or industrial scenario, then a basement depth must be input into cell #208 (see below). Restricting the building type will normally lead to land-use restrictions.

Cell #25 allows for the exclusion of the offsite migration pathway for industrial sites if the surrounding land use is also industrial.

3.2 Adjusting Model Parameters

The remaining input cells on the **T2_Input** worksheet allow for the adjustment of model parameters. Input cells should be left blank unless a site-specific value is being entered for that parameter.

The symbol “*” appears to the left of any parameter used in the calculation of either the Tier 1 governing pathway for any PHC fraction, or the current Tier 2 governing pathway (based on input already entered).

The letter “X” appears to the right of any input cell if the value entered is outside the commonly encountered ranges specified in the User Guidance (Table 8). This situation may not in and of itself lead to any restrictions; however, the user should be certain the value entered is correct and representative. Significant deviations from these ranges may lead to the requirement for Tier 3 assessment at the discretion of the jurisdiction.

Comments may appear to the right of the input cells if the value entered is invalid or leads to potential restrictions.

Comments may also appear if site-specific values are entered for one parameter, but not for closely linked parameters. This occurs for any of the following sets of linked parameters:

- Source length and source width (#101 and #102);
- Soil bulk density and water content (#111 and #112);
- Saturated hydraulic conductivity and hydraulic gradient (#113 and #114);

- Building width and length
- Depth to groundwater and thickness of contamination (#103 and #105); depth to contamination must also be entered with these two parameters.

The proponent must ensure that sufficient supporting data have been obtained to support any site-specific values entered into the worksheet; a single measurement is not normally sufficient.

3.2.1 Primary User-Adjustable Parameters

The primary user-adjustable parameters (cells #101 through #116) are those for which relatively stable values can be measured; these parameters normally do not lead to land use restrictions.

Detailed information on the primary user-adjustable parameters is presented in Section C.1 of the User Guidance, including methods of measurement and how the parameters influence Tier 2.

3.2.2 Secondary User-Adjustable Parameters

Secondary user-adjustable parameters (cells #201 through #212) are typically either parameters leading to restrictions or ongoing management requirements, or parameters which are difficult to measure accurately and reliably, as discussed in Section C.4 of the User Guidance. Adjustment of these parameters may not be permitted at Tier 2 by some jurisdictions.

3.2.3 PHC Composition

The composition of PHC fractions can also be altered. Details are provided in Section C.2 of the User Guidance. If PHC composition is altered, it is important that the values applied conservatively represent the PHC composition at the site. Multiple samples should be analysed to evaluate the PHC composition, and consideration should be given to the relative toxicity and mobility of the sub-fractions to ensure a conservative PHC composition is applied. Adjustment of PHC composition may not be permitted at Tier 2 by some jurisdictions. It is recommended that only users with a firm grasp of the chemistry and toxicology of the PHC sub-fractions attempt to modify the PHC composition.

Note that the sum of the mass-percents for all sub-fractions within a fraction must equal 100, or an error will be generated.

3.3 Results of Tier 2

Once the Tier 2 input has been completed, the user can either click the hyperlink in cell C4 or select the **T2_Output** worksheet. A hyperlink leading back to the Tier 1 worksheet has also been provided.

The Tier 2 output sheet displays the project information at the top of the worksheet; immediately below this is a table displaying the Tier 2 evaluation results. This table displays the governing Tier 2 objective for each PHC fraction and the governing pathway. Beneath this is a listing of the Tier 2 levels by pathway.

Below the Tier 2 evaluation results table is a summary of all adjustable input parameters, including the scenario definition. Any parameters for which site-specific values have been entered appear in bold underlined font, and any restrictions or other comments associated with the value entered are also displayed.

3.4 Tier 2 Decision

Below the summary of input parameters is a section designed to assist with the Tier 2 decision. A hyperlink leading to this section is in cell M3. Section 3.3 of the User Guidance should be consulted at this stage.

The results of the Tier 2 adjustments are evaluated by the spreadsheet, and for each fraction there will be a comment indicating whether the Tier 2 adjustments resulted in a significant improvement over Tier 1 (i.e. a factor of 2 or more), a slight improvement, or no improvement. Additionally, a comment will appear if any of the Tier 2 objectives are lower than the corresponding Tier 1 objectives by at least a factor of 2; this situation may indicate that the Tier 1 scenario is not sufficiently protective at the site and the jurisdiction should be consulted.

The user is then given four options:

- Returning to Tier 1 (a hyperlink is provided);
- Accepting this Tier 2 scenario and printing the output sheet;
- Returning to the Tier 2 input sheet to refine the scenario (a hyperlink is provided);
- Proceeding to Tier 3

A print area has been defined for the Tier 2 output worksheet, so that the project information, Tier 2 results, and summary of input parameters will all print on a single page. This page can be appended to relevant reports for ease of regulatory review. It should be noted that including this page in a report does not relax the requirements to provide sufficient site-specific data to support any Tier 2 adjustments.

4.0 TIER 3

Tier 3 site-specific risk assessment is beyond the scope of the spreadsheet. Users who are proceeding to Tier 3 should consult Section 4.0 of the User Guidance, along with other relevant regulatory and guidance documents.

If models specified in the PHC CWS Scientific Rationale are used for the Tier 3 risk assessment, then parts of the spreadsheet may be of use; however, it is not expected that the spreadsheet will be used in its entirety at Tier 3.

DISCLAIMER

This spreadsheet model has been developed by Meridian Environmental Inc. (Meridian), under contract to the Canadian Council of Ministers of the Environment (CCME), in support of the Canada Wide Standard for Petroleum Hydrocarbons in Soil. The model is strictly a spreadsheet-based implementation of the equations, algorithms, default parameters and other information presented in the Standard and supporting documents. While the spreadsheet model is believed to be free of errors, neither Meridian nor CCME makes any representation or warranty as to the accuracy and completeness of the spreadsheet model.

Meridian, CCME, and their respective employees shall not accept any liability for the results or consequences of any actions taken or decisions made based on the use of this spreadsheet model. Use of this spreadsheet model does not in any way relieve the user of responsibility for compliance with all applicable regulatory requirements.

CCME reserves the right to update or modify this spreadsheet model at any time.

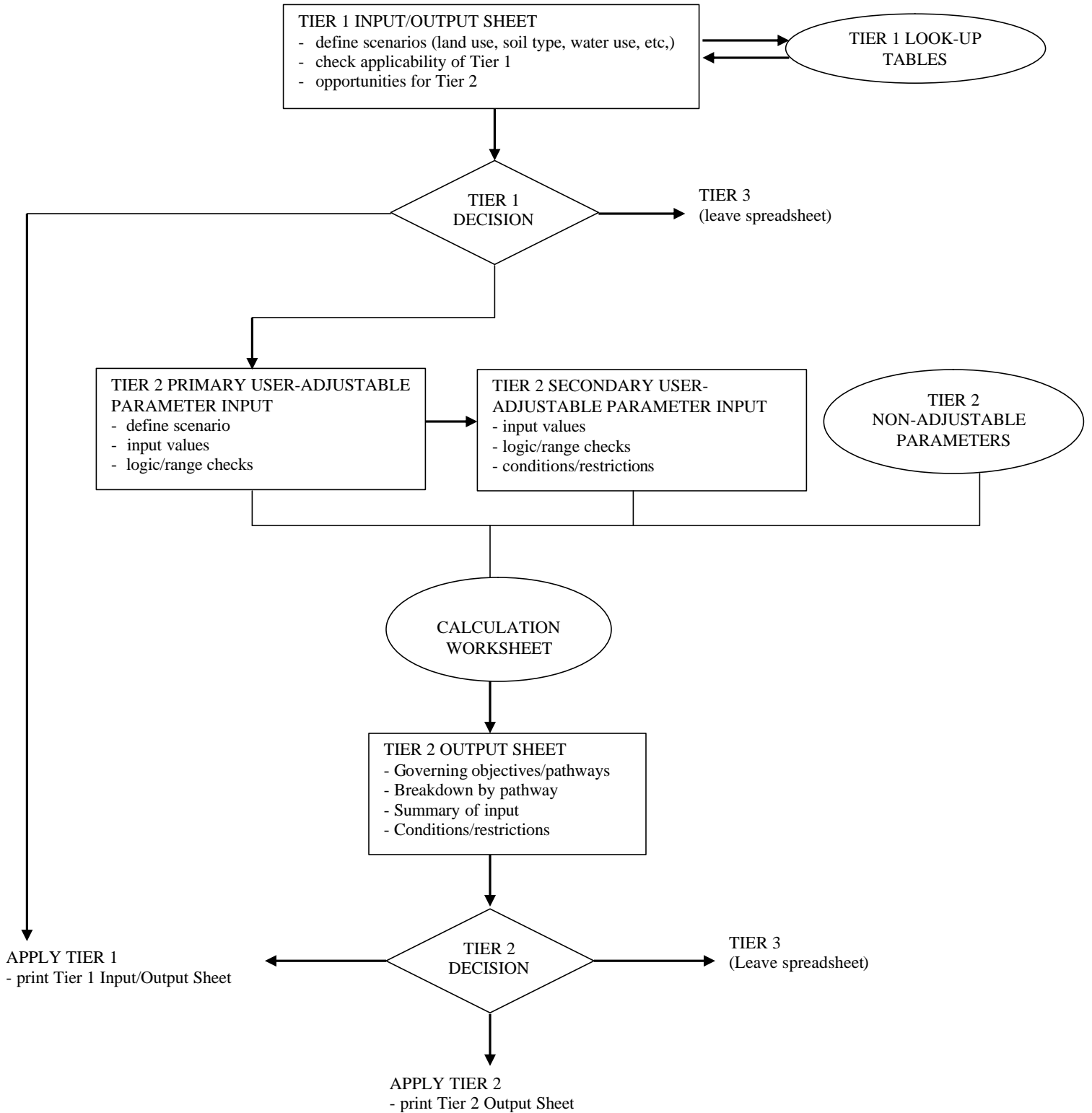
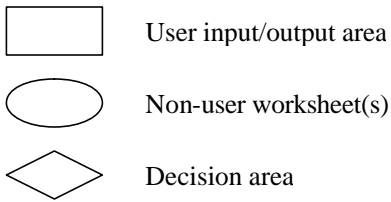


Figure 1: Spreadsheet Program Conceptual Design