CE 3354 ENGINEERING HYDROLOGY

LECTURE 14: UNIT HYDROGRAPHS

OUTLINE

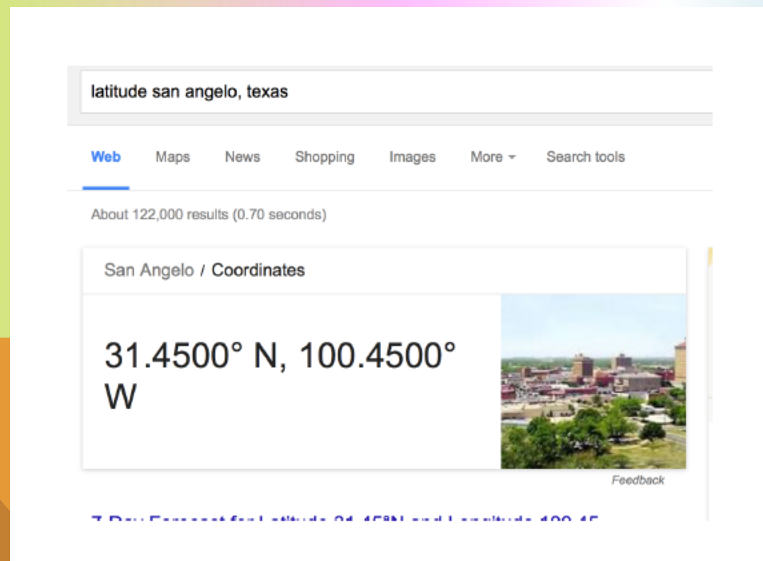
- ES6 Solution Sketch
- Unit Hydrographs/HMS Workshop
  - CMM pp. 201-223
- HMS Workshop

ES-6 SOLUTION SKETCH

ES 6 was application of two different evaporation models

1. Estimate the monthly evapotranspiration depths for the San Angelo (Concho County) area using the Blaney-Criddle method.[1]

- **The Blaney-Criddle method uses location (latitude) and mean monthly temperatures in Celsius**
  - Google search <Latitude and Longitude for San Angelo, Texas>



ES-6 SOLUTION SKETCH

- **The Blaney-Criddle method uses location (latitude) and mean monthly temperatures in Celsius**
  - Google search <Mean Monthly Temperature for San Angelo, Texas>

U.S. climate data

Temperature - Precipitation - Sunshine - Snowfall

Home United States Texas

Monthly Daily History Geo & Map Weather Forecast

Climate San Angelo - Texas °C | °F

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F:	60	64	71	80	87	92
Average low in °F:	33	37	44	52	62	69
Av. precipitation in inch:	0.94	1.34	1.5	1.42	2.83	2.6
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	1	0	0	0	0	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	95	95	88	79	68	60
Average low in °F:	71	71	64	54	42	34
Av. precipitation in inch:	1.18	2.24	2.44	2.72	1.14	0.87
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-

Need in Celsius,
So either convert or select Celsius

ES-6 SOLUTION SKETCH

Put these results into Blaney-Criddle equation

	A	B	C	D	E	F	G	H
1	Blaney-Criddle ET Estimator							
2	North Latitude							
3								
4	Latitude	30	<=Degrees Latitude (0-60, increments of 5)					
5								
6	Month	T_mean	p-Value	ET_o		T-high	T-low	
7	Jan	8	0.24	2.8032		15.3	0.7	
8	Feb	10.15	0.25	3.16725		17.5	2.8	
9	Mar	14.3	0.27	3.93606		21.7	6.9	
10	Apr	18.9	0.29	4.84126		26.7	11.1	
11	May	23.65	0.31	5.85249		30.7	16.6	
12	Jun	26.9	0.32	6.51968		33.4	20.4	
13	Jul	28.45	0.31	6.53697		35.1	21.8	
14	Aug	28.15	0.3	6.2847		34.8	21.5	
15	Sep	24.25	0.28	5.3634		31	17.5	
16	Oct	19	0.26	4.3524		26	12	
17	Nov	12.95	0.24	3.34968		20.2	5.7	
18	Dec	8.2	0.23	2.70756		15.5	0.9	
19								
20								

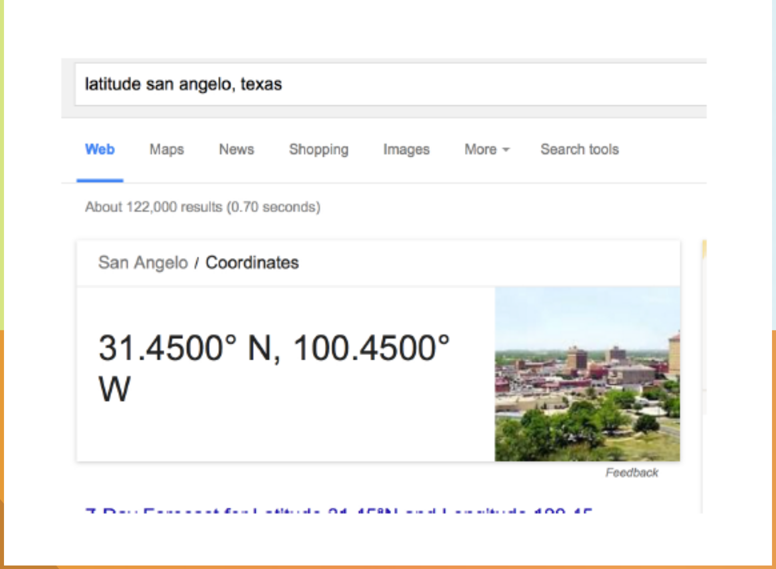
North-Latitude | South-Latitude | p-factor

ES-6 SOLUTION SKETCH

ES 6 was application of two different evaporation models

2. Estimate the monthly evapotranspiration depths for the San Angelo (Concho County) area using the Thornwaithe method.[2]

- **The Thornwaithe method uses location (latitude) and mean monthly temperatures in Celsius**
  - Google search <Latitude and Longitude for San Angelo, Texas>



ES-6 SOLUTION SKETCH

- **The Thornwaithe method uses location (latitude) and mean monthly temperatures in Celsius**
  - Google search <Mean Monthly Temperature for San Angelo, Texas>

U.S. climate data

Temperature - Precipitation - Sunshine - Snowfall

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Climate San Angelo - Texas °C | °F

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F:	60	64	71	80	87	92
Average low in °F:	33	37	44	52	62	69
Av. precipitation in inch:	0.94	1.34	1.5	1.42	2.83	2.6
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	1	0	0	0	0	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	95	95	88	79	68	60
Average low in °F:	71	71	64	54	42	34
Av. precipitation in inch:	1.18	2.24	2.44	2.72	1.14	0.87
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-

Need in Celsius,
So either convert or select Celsius

ES-6 SOLUTION SKETCH

Put these results into Thornwaithe method

Thornwaithe.xls

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Thornwaithe Method Worksheet													
2	Instructions:													
3	(1) Enter mean monthly air temperature in data field													
4	(2) Enter nearest latitude of study area (see data table to see latitudes available)													
5	**Required Data**		January	February	March	April	May	June	July	August	September	October	November	December
6	Mean Monthly Air Temperature (°C)		8	10.15	14.3	18.9	23.65	26.9	28.45	28.15	24.25	19	12.95	8.2
7	Station Latitude (°North)		30											
8	**Computed Values**													
9	Monthly Thermal Index (i)		2.03722	2.92112	4.90838	7.48725	10.5133	12.7763	13.9072	13.6858	10.9198	7.54731	4.22412	2.11482
10	Monthly Correction Coefficient (F(λ))		0.9	0.87	1.03	1.08	1.18	1.17	1.2	1.14	1.03	0.98	0.89	0.88
11	Annual Thermal Index (I)		93.0426											
12	Exponent (a)		2.03	6.75E-07	7.71E-05	1.79E-02	0.49239							
13	Monthly Potential ET (mm)		10.6	16.6	39.5	73.0	125.9	162.2	186.5	173.4	115.7	67.0	27.9	10.9

	Latitude North	January	February	March	April	May	June	July	August	September	October	November	December
16	50	0.74	0.78	1.02	1.15	1.33	1.36	1.37	1.25	1.06	0.92	0.76	0.7
17	49	0.75	0.79	1.02	1.14	1.32	1.34	1.35	1.24	1.05	0.93	0.76	0.71
18	48	0.76	0.8	1.02	1.14	1.31	1.33	1.34	1.23	1.05	0.93	0.77	0.72
19	47	0.77	0.8	1.02	1.14	1.3	1.32	1.33	1.22	1.04	0.93	0.78	0.73
20	46	0.79	0.81	1.02	1.13	1.29	1.31	1.32	1.22	1.04	0.94	0.79	0.74
21	45	0.8	0.81	1.02	1.13	1.28	1.29	1.31	1.21	1.04	0.94	0.79	0.75
22	44	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76
23	43	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77
24	42	0.82	0.83	1.03	1.12	1.26	1.27	1.28	1.19	1.04	0.95	0.82	0.79
25	41	0.83	0.83	1.03	1.11	1.25	1.26	1.27	1.19	1.04	0.96	0.82	0.8
26	40	0.84	0.83	1.03	1.11	1.24	1.25	1.27	1.18	1.04	0.96	0.83	0.81

ThornwaitheMethod | F(lambda)

ES6 SOLUTION SKETCH

Blaney-Criddle Results:

The results indicate a high value of about 1/4 inch/day during the summer months, and about 1/10 inch per day in the winter months.

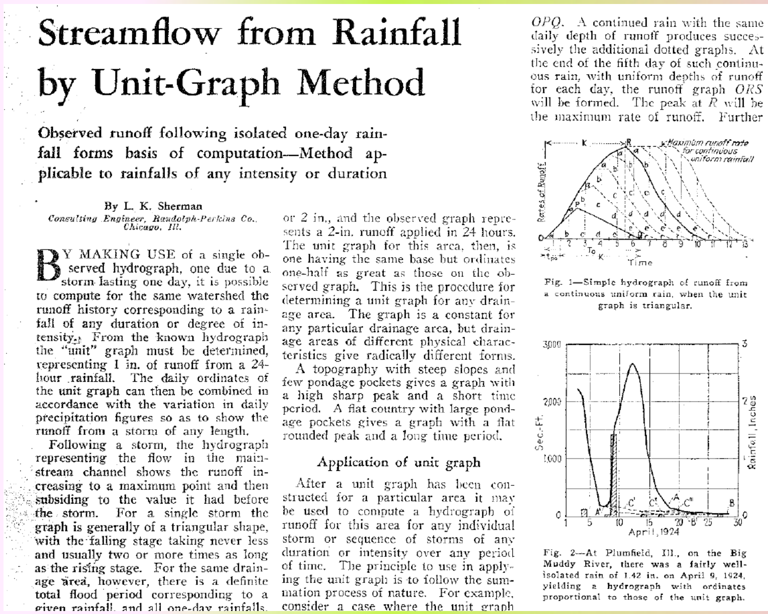
Thornwaithe Results:

The results indicate a daily rate of about 1/4 inch/day per day in the summer months and about 0.01 inches per day in the winter months.

Is evaporation for a 24-hour storm?

3. How important are these estimates in the drainage analysis project for a storm lasting 24-48 hours? Probably not terribly important for rainfall rates in excess of 1 inches per hour.

WHAT IS A UNIT HYDROGRAPH?



Streamflow from Rainfall by Unit-Graph Method

Observed runoff following isolated one-day rainfall forms basis of computation—Method applicable to rainfalls of any intensity or duration

By L. K. Sherman
Consulting Engineer, Randolph-Perkins Co., Chicago, Ill.

BY MAKING USE of a single observed hydrograph, one due to a storm lasting one day, it is possible to compute for the same watershed the runoff history corresponding to a rainfall of any duration or degree of intensity. From the known hydrograph the "unit" graph must be determined, representing 1 in. of runoff from a 24-hour rainfall. The daily ordinates of the unit graph can then be combined in accordance with the variation in daily precipitation figures so as to show the runoff from a storm of any length.

Following a storm, the hydrograph representing the flow in the main-stream channel shows the runoff increasing to a maximum point and then subsiding to the value it had before the storm. For a single storm the graph is generally of a triangular shape, with the falling stage taking never less and usually two or more times as long as the rising stage. For the same drainage area, however, there is a definite total flood period corresponding to a given rainfall, and all one-day rainfalls, or 2 in., and the observed graph represents a 2-in. runoff applied in 24 hours. The unit graph for this area, then, is one having the same base but ordinates one-half as great as those on the observed graph. This is the procedure for determining a unit graph for any drainage area. The graph is a constant for any particular drainage area, but drainage areas of different physical characteristics give radically different forms.

A topography with steep slopes and few pondage pockets gives a graph with a high sharp peak and a short time period. A flat country with large pondage pockets gives a graph with a flat rounded peak and a long time period.

Application of unit graph

After a unit graph has been constructed for a particular area it may be used to compute a hydrograph of runoff for this area for any individual storm or sequence of storms of any duration or intensity over any period of time. The principle to use in applying the unit graph is to follow the summation process of nature. For example, consider a case where the unit graph

OPQ. A continued rain with the same daily depth of runoff produces successively the additional dotted graphs. At the end of the fifth day of such continuous rain, with uniform depths of runoff for each day, the runoff graph *ORS* will be formed. The peak at *R* will be the maximum rate of runoff. Further

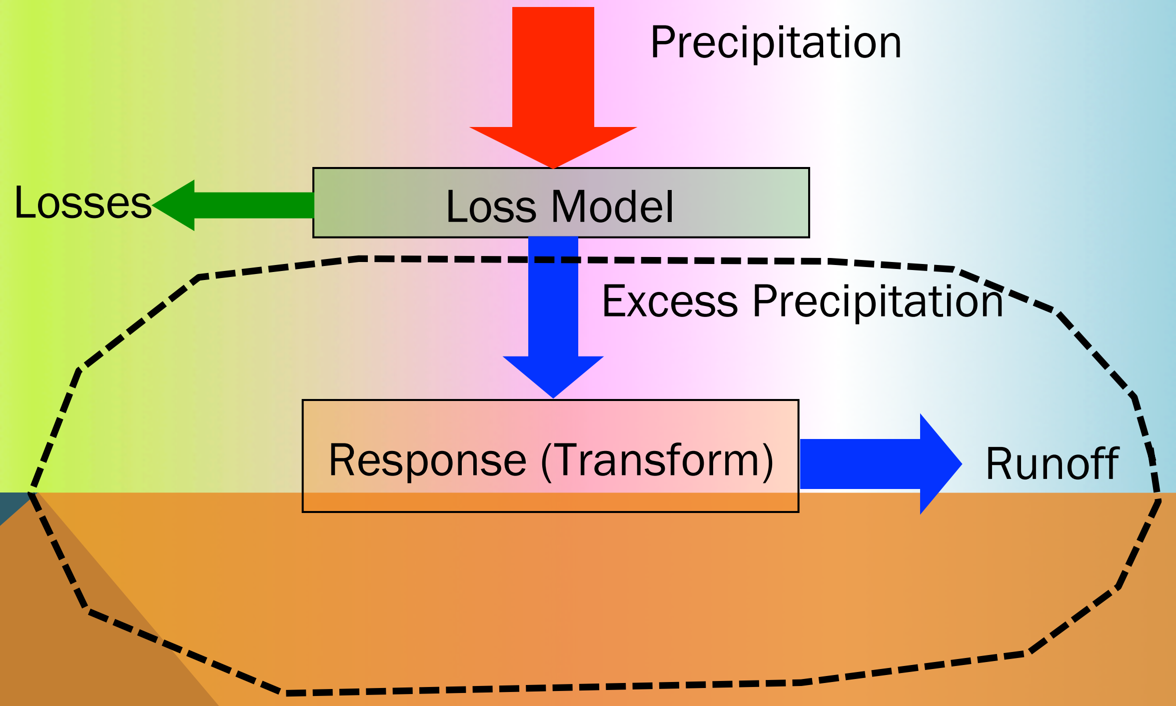
Fig. 1—Simple hydrograph of runoff from a continuous uniform rain, when the unit graph is triangular.

Fig. 2—At Plumfield, Ill., on the Big Muddy River, there was a fairly well-isolated rain of 1.42 in. on April 9, 1924, yielding a hydrograph with ordinates proportional to those of the unit graph.

- **Used to explain the time re-distribution of excess precipitation on a watershed**
- **Represents the response of the watershed at the outlet to a unit depth of EXCESS precipitation**
  - EXCESS implies some kind of loss model is applied to the raw precipitation
  - Time re-distribution implies some kind of transfer behavior is applied
- **L. K. Sherman 1932 is credited with seminal publication of the concept**
  - Read the document in AdditionalReadings

RESPONSE MODEL

Response models convert the excess precipitation signal into a direct runoff hydrograph at the point of interest



CE 3354 Engineering Hydrology

Lecture 15: HEC-HMS Workshop – Ash Creek Example

PURPOSE

Illustrate the steps to create a functioning precipitation-runoff model in HEC-HMS

- Only a small set of HEC-HMS capabilities are employed
  - Basin Model
    - Sub-Basin: IaCl Loss Model; DUH Transform Model
  - Meterological Model
  - Control Specifications
  - Time-Series: Rain Gage
  - Time-Series: Discharge Gage
- Realistic parameter values are employed from class references

LEARNING OBJECTIVES

Familiarize students with the HEC-HMS Graphical User Interface.

- Reinforce the concepts of "Projects" as a data-storage paradigm.

Simulate the rainfall-runoff response of a single sub-basin Texas watershed using:

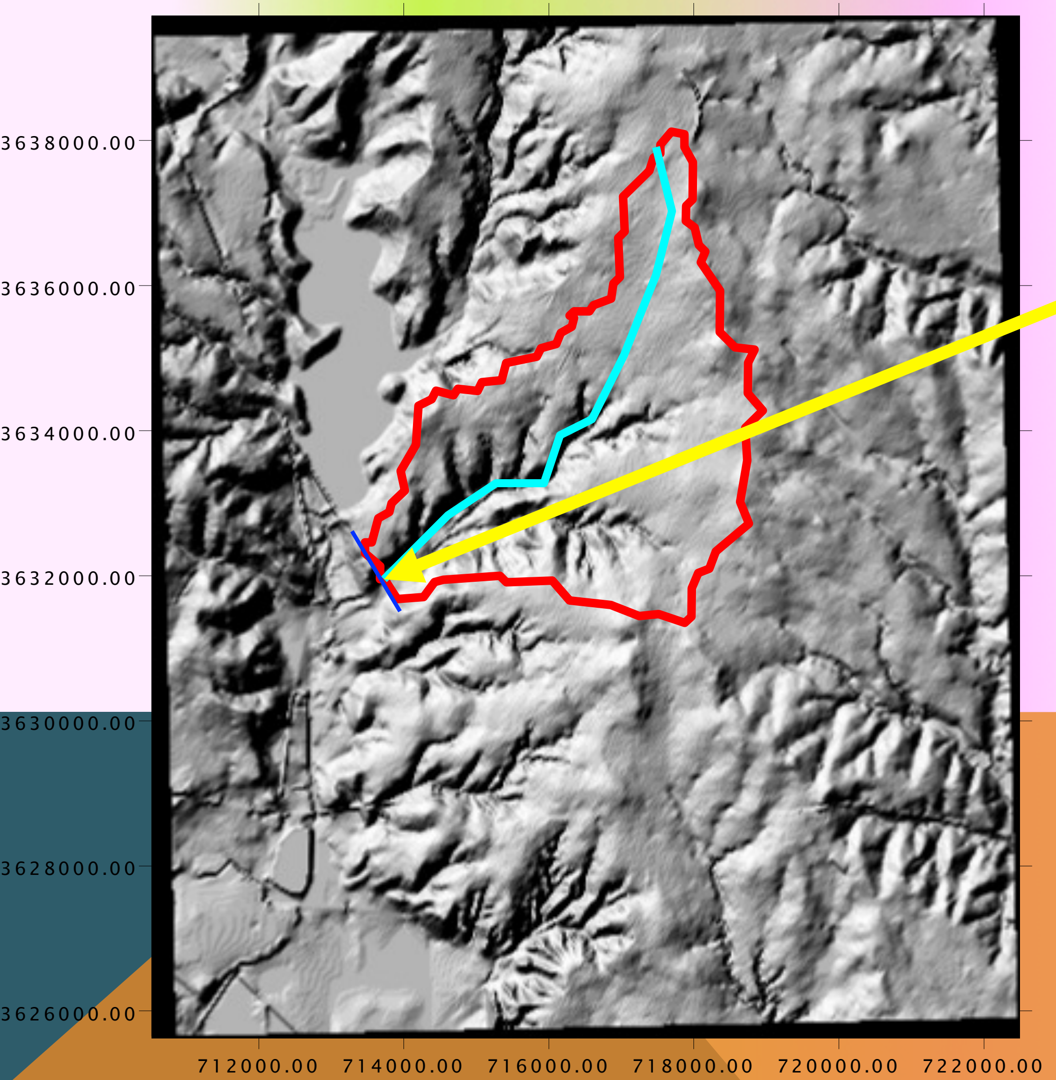
- Initial loss and constant rate loss model
- SCS Unit Hydrograph transformation model
- User-specified hyetograph.

PROBLEM STATEMENT

Simulate the response of the Ash Creek watershed at Highland Road for a 5-year, 3-hour storm, under current development conditions.

- Treat the entire watershed as a single sub-basin.

PROBLEM STATEMENT



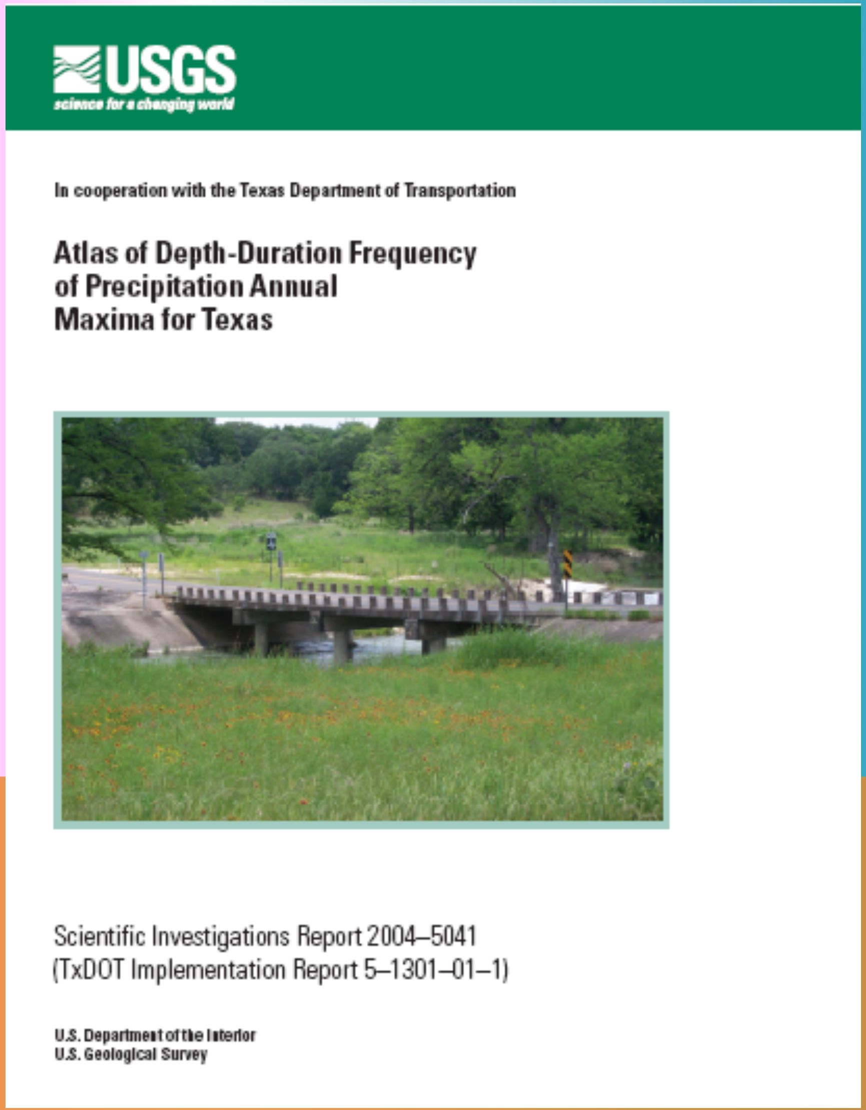
Watershed Outlet

- Highland Road and Ash Creek, Dallas, TX.
- Area is residential subdivisions, light industrial parks, and some open parkland.
- White Rock Lake is water body to the North-West

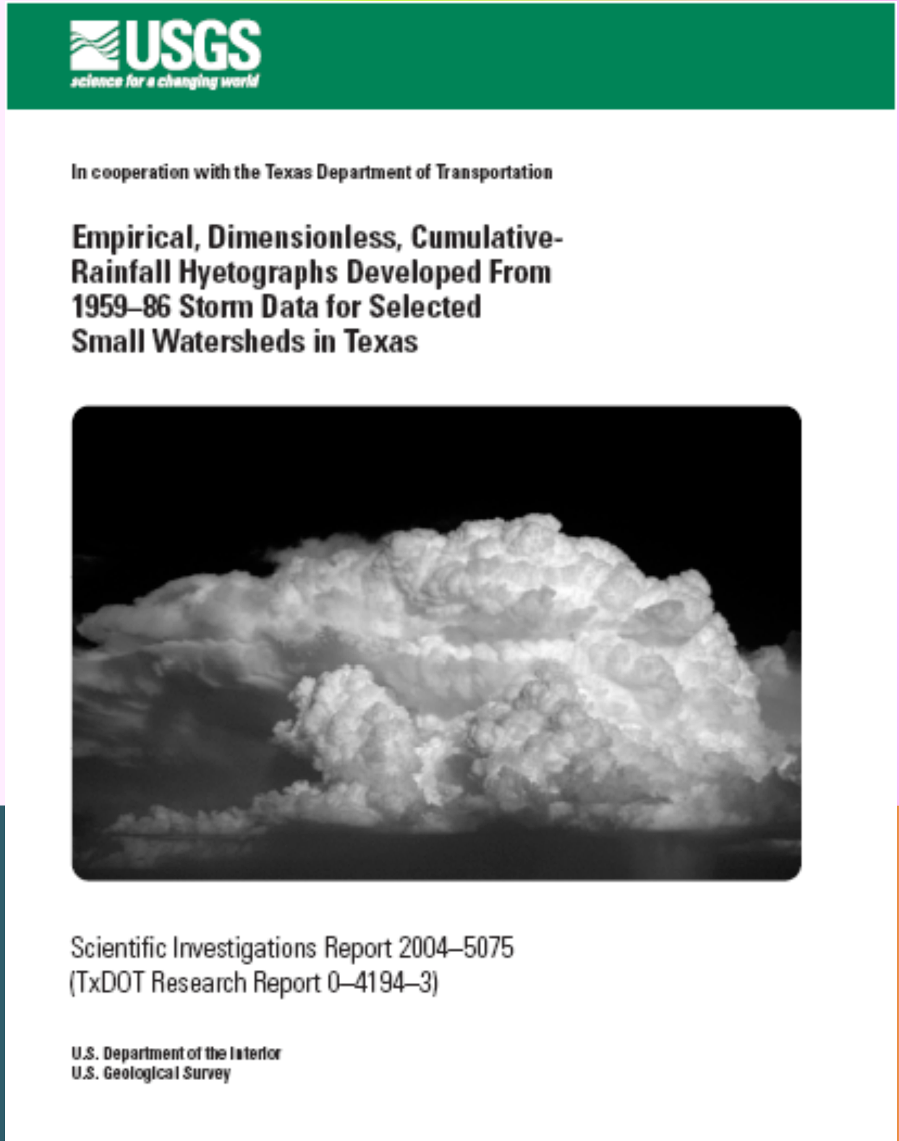
PRECIPITATION ESTIMATION

Precipitation

- Estimate 5-year, 3-hour storm depth using the DDF Atlas



PRECIPITATION ESTIMATION


USGS
science for a changing world

In cooperation with the Texas Department of Transportation

Empirical, Dimensionless, Cumulative-Rainfall Hyetographs Developed From 1959–86 Storm Data for Selected Small Watersheds in Texas

Scientific Investigations Report 2004–5075
(TxDOT Research Report 0–4194–3)

U.S. Department of the Interior
U.S. Geological Survey

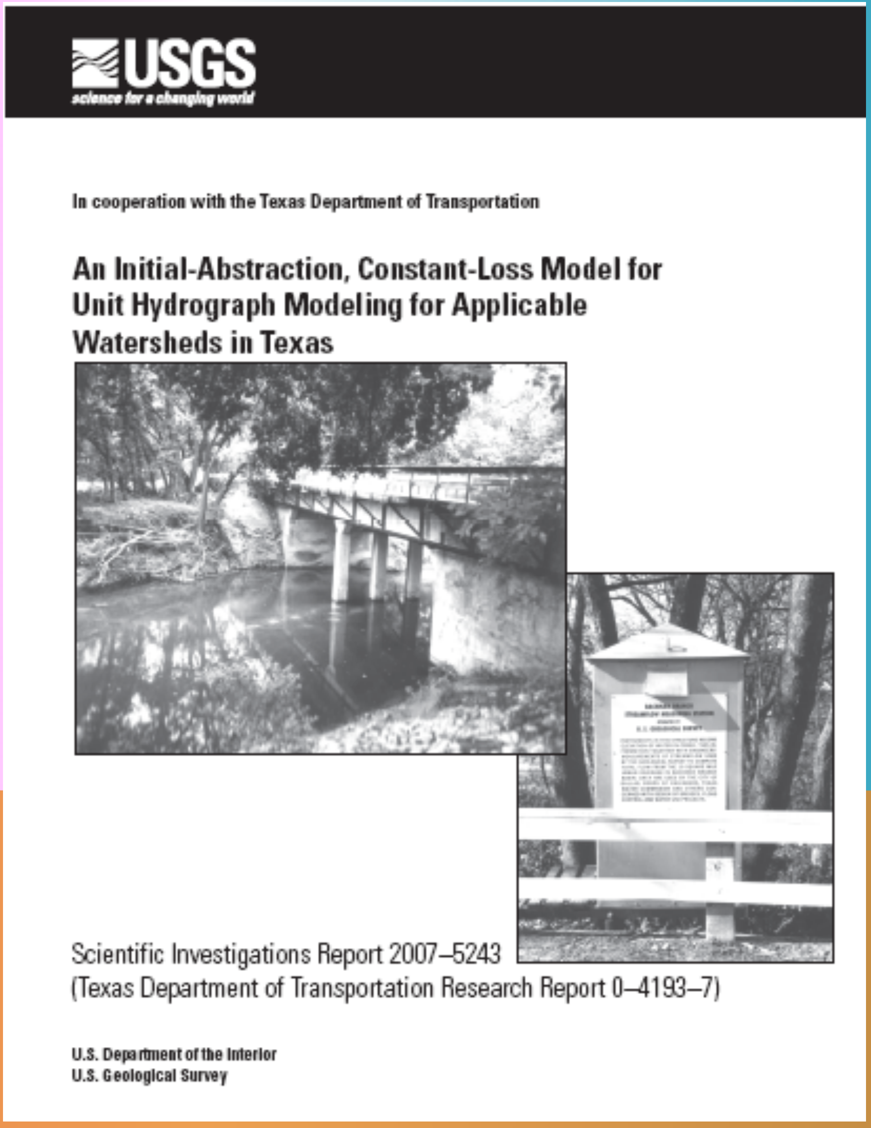
Precipitation

- Approximate the storm temporal distribution using dimensionless hyetograph.

LOSS MODEL ESTIMATION

Runoff Generation (Loss)

- Estimate the initial loss and constant rate loss using TxDOT 0-4193-7


USGS
science for a changing world

In cooperation with the Texas Department of Transportation

An Initial-Abstraction, Constant-Loss Model for Unit Hydrograph Modeling for Applicable Watersheds in Texas

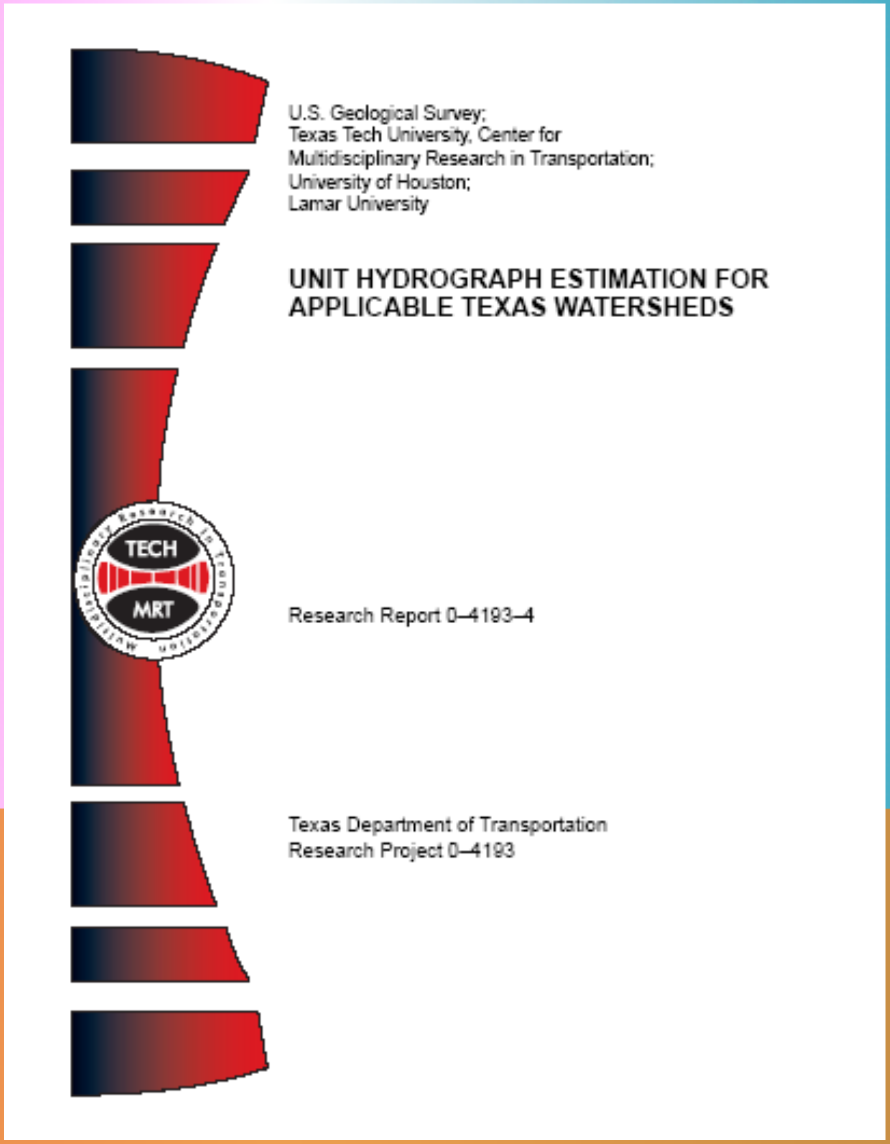
Scientific Investigations Report 2007–5243
(Texas Department of Transportation Research Report 0–4193–7)

U.S. Department of the Interior
U.S. Geological Survey

TRANSFORMATION MODEL ESTIMATION

Unit Hydrograph Timing Parameters

- Example will use the SCS DUH, but will parameterize assuming GUHAS regression is appropriate.



U.S. Geological Survey;
Texas Tech University, Center for Multidisciplinary Research in Transportation;
University of Houston;
Lamar University

UNIT HYDROGRAPH ESTIMATION FOR APPLICABLE TEXAS WATERSHEDS

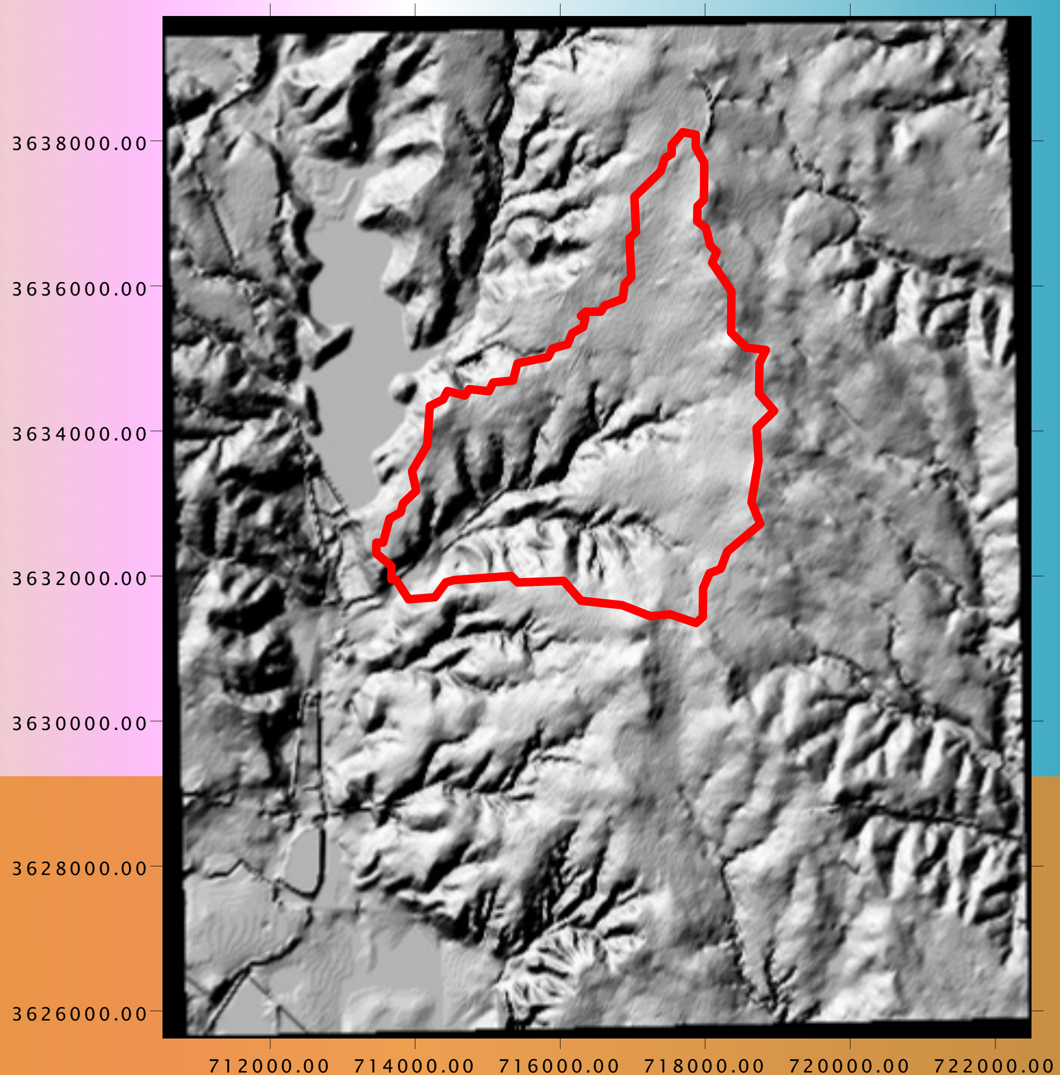
Research Report 0–4193–4

Texas Department of Transportation
Research Project 0–4193

PHYSICAL PROPERTIES

Watershed Properties

- AREA=6.92 mi2
- MCL=5.416 mi
- MCS=0.005595
- CN=86
- R=0



BUILDING THE MODEL – DATA PREPARATION

HEC-HMS will require us to construct, external to HMS the following:

- A Hyetograph (rainfall)
- Loss model parameters
- Transform model parameters

In this example will use Excel to build some input data required by the program.

RAINFALL DEPTH

Use the DDF atlas to find the 5-year, 3-hour storm depth for Dallas Texas.

- About 2.8 in.

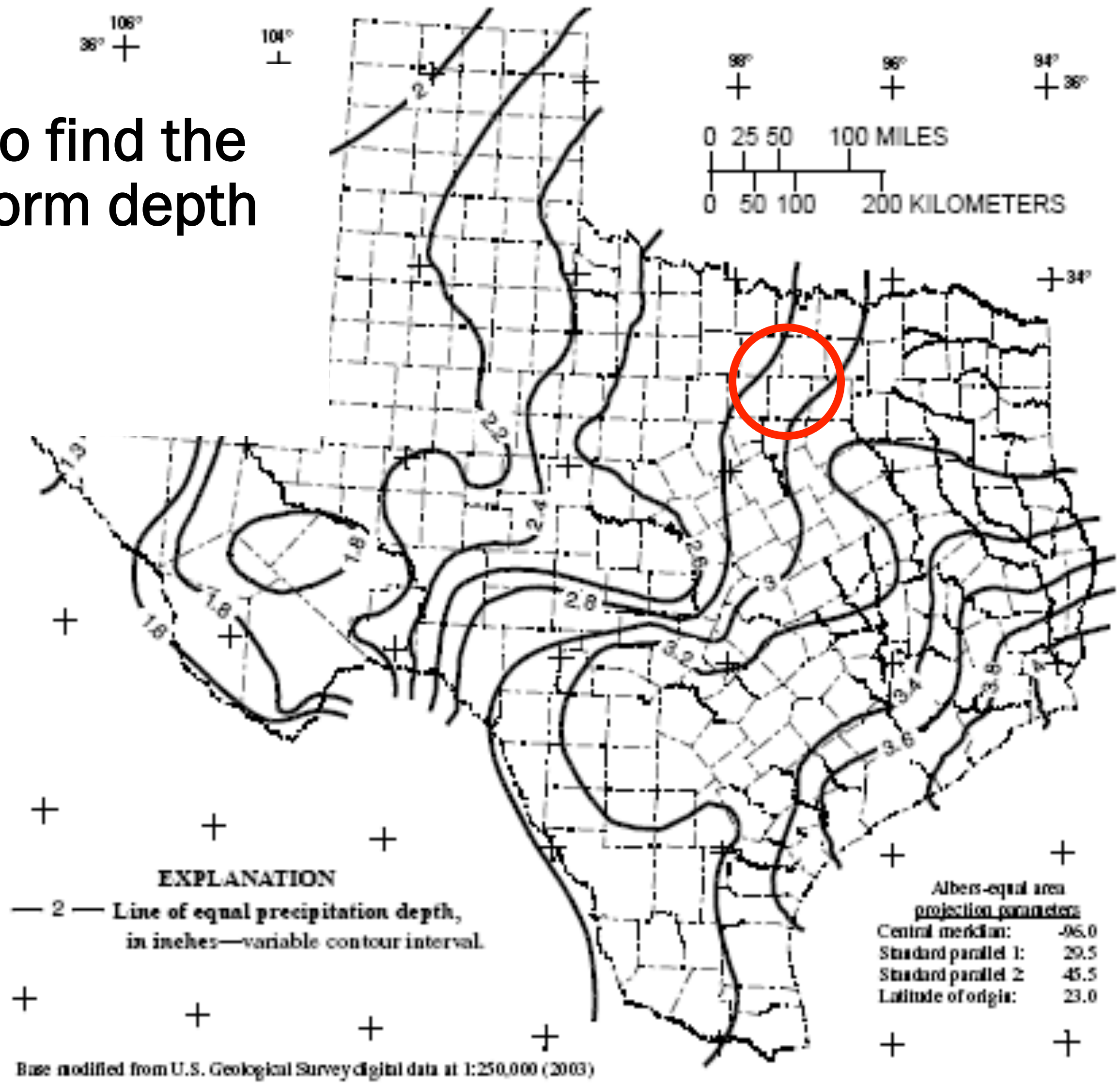


Figure 20. Depth of precipitation for 5-year storm for 3-hour duration in Texas.

GENERATE A HYETOGRAPH – USE TXHYETO

TXHYETO-2015-PreRelease.xlsx

TxHYETO-2015 Pre-Release

Texas Hyetographs for 50-th Percentile Storm

(Revised: July 30, 2015)

1. Enter a Storm Duration

(from DDF Atlas, TP40, or equivalent)

3 hours

2. Enter a Storm Depth

(from TxDOT Hydraulic Design Manual, EBDLKUP-NEW.xlsx, DDF Atlas, TP40, or equivalent)

2.8 inches

3. Enter a desired Time Interval

(recommend intervals perfectly divisible by storm duration)

5 minutes

Mixture Model Parameters (50th)

w_1	1.038977
a	0.795463
b	3.485892
w_2	0.248833
m	0.471874
s	0.283391

50TH PERCENTILE (2-YEAR) HYETOGRAPH

Time (min)	*Time (hrs)*	*Depth (in)*
0	0	0.000
5	0.08	0.176
10	0.17	0.446
15	0.25	0.660
20	0.33	0.835
25	0.42	0.980
30	0.50	1.100
35	0.58	1.200
40	0.67	1.282
45	0.75	1.351
50	0.83	1.409
55	0.92	1.459
60	1.00	1.503
65	1.08	1.543
70	1.17	1.581
75	1.25	1.620
80	1.33	1.659
85	1.42	1.701
90	1.50	1.747
95	1.58	1.796
100	1.67	1.848
105	1.75	1.905
110	1.83	1.964
115	1.92	2.027
120	2.00	2.091
125	2.08	2.157
130	2.17	2.222
135	2.25	2.287
140	2.33	2.351
145	2.42	2.412

50th Percentile | 90th Percentile

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LOSS MODEL PARAMETERS

$I_a C_l$ model in TxDOT 0-4193-7

Estimation of Initial Abstraction

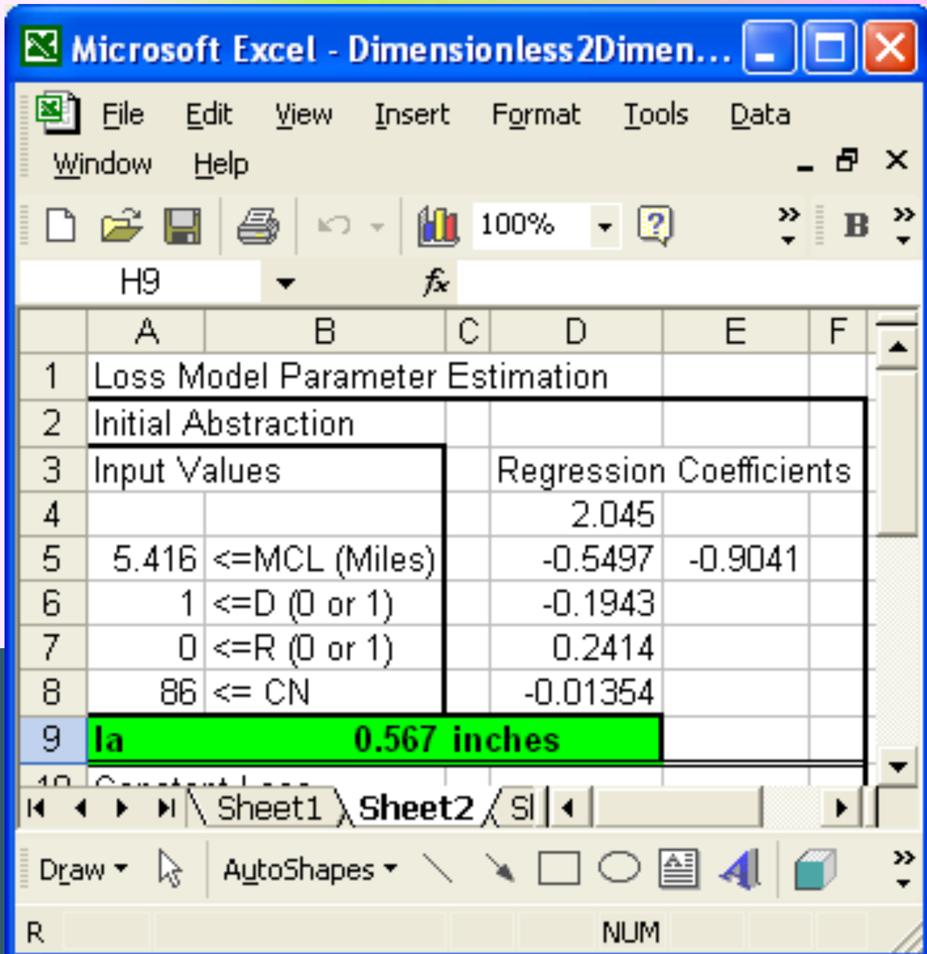
The regression equation[15] for estimation of I_A has $\varphi^{[I_A]} = -0.9041$ and is

$$I_A = 2.045 - 0.5497L^{-0.9041} - 0.1943D + 0.2414R - 0.01354CN, \qquad (23)$$

where I_A is initial abstraction in watershed inches, L is main-channel length of the watershed in miles, $D = 0$ for undeveloped watersheds and $D = 1$ for developed watersheds, $R = 0$ for non-rocky watersheds and $R = 1$ for rocky watersheds, and CN is the curve number.

LOSS MODEL PARAMETERS

I_aC_l model in TxDOT 0-4193-7


Microsoft Excel - Dimensionless2Dimen...

	A	B	C	D	E	F
1	Loss Model Parameter Estimation					
2	Initial Abstraction					
3	Input Values			Regression Coefficients		
4				2.045		
5	5.416	<=MCL (Miles)		-0.5497	-0.9041	
6	1	<=D (0 or 1)		-0.1943		
7	0	<=R (0 or 1)		0.2414		
8	86	<= CN		-0.01354		
9	**Ia**	**0.567 inches**				

LOSS MODEL PARAMETERS

$I_a C_l$ model in TxDOT 0-4193-7

Estimation of Constant Loss

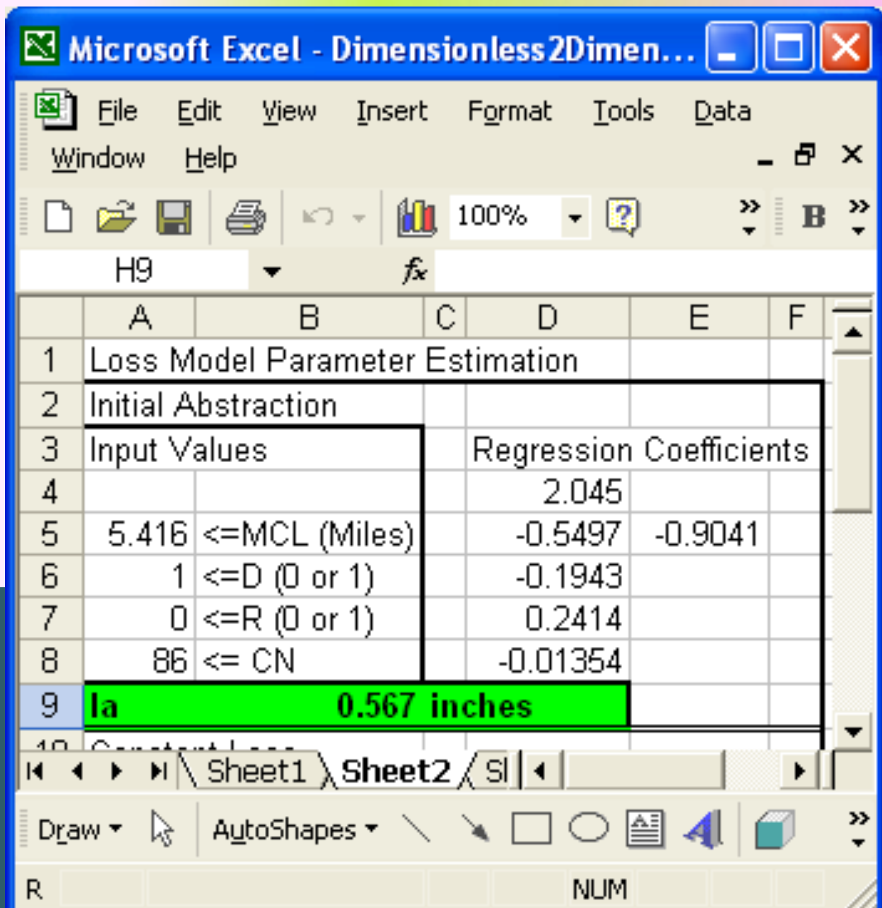
The regression equation[16] for estimation of C_L has $\varphi^{[C_L]} = 0.2312$ and is

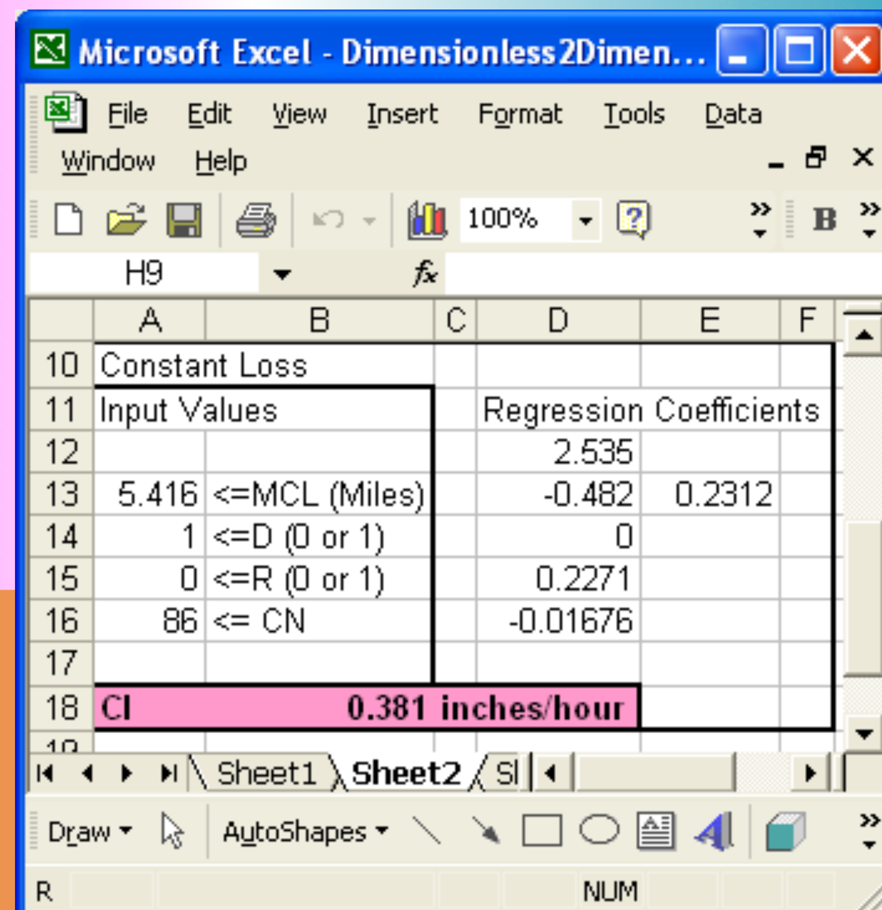
$$C_L = 2.535 - 0.4820L^{0.2312} + 0.2271R - 0.01676CN, \tag{29}$$

where C_L is constant loss in watershed inches per hour, L is main-channel length of the watershed in miles, $R = 0$ for non-rocky watersheds and $R = 1$ for rocky watersheds, and CN is curve number. The equation has

LOSS MODEL PARAMETERS

I_aC_l model in TxDOT 0-4193-7





DATA PREPARATION

HEC-HMS will require us to construct, external to HMS the following:

- *A Hyetograph (rainfall)*
- *Loss model parameters*
- Transform model parameters

In this example will use Excel to build some input data required by the program.

UNIT HYDROGRAPH MODEL

SCS Dimensionless Unit Hydrograph

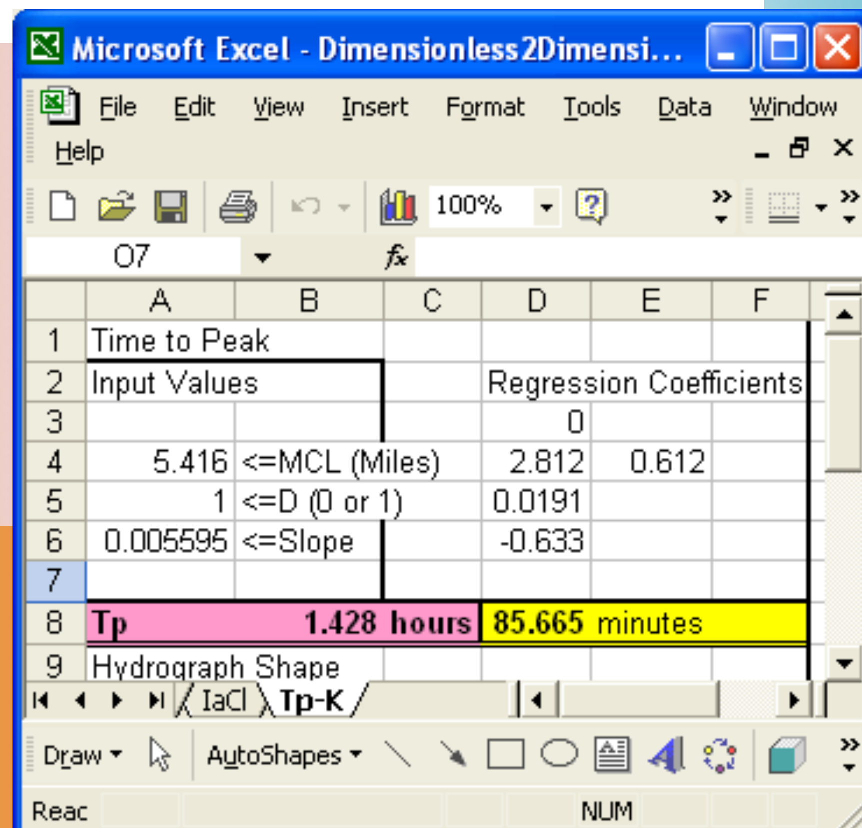
- Related to a gamma distribution with shape K=3.77
- HEC-HMS requires a time constant, T_lag

For this example, will assume 0-4193-4 method is sufficient

UNIT HYDROGRAPH MODEL

Estimate Tp

$$T_p = 10^{(-1.41 - 0.313D)} L^{0.612} S^{-0.633},$$

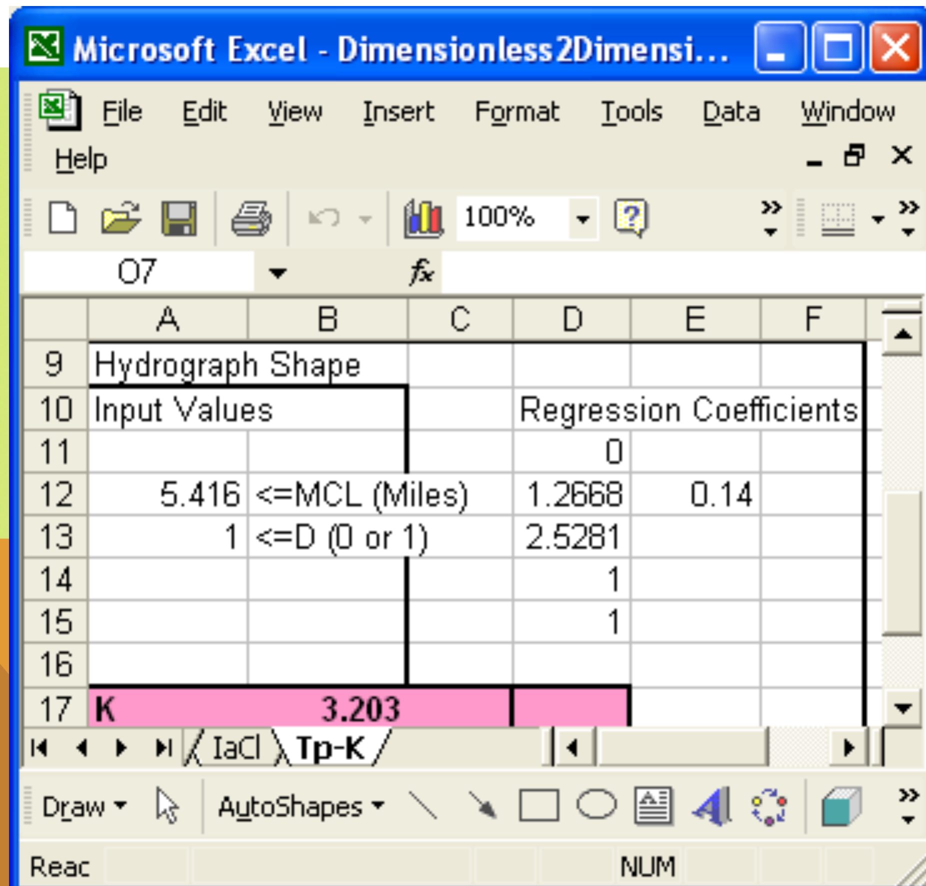


	A	B	C	D	E	F
1	Time to Peak					
2	Input Values			Regression Coefficients		
3				0		
4	5.416	<=MCL (Miles)		2.812	0.612	
5	1	<=D (0 or 1)		0.0191		
6	0.005595	<=Slope		-0.633		
7						
8	**Tp**	**1.428 hours**		**85.665** minutes		
9	Hydrograph Shape					

UNIT HYDROGRAPH MODEL

Estimate K

$$K = 10^{(0.481 - 0.0782D)} L^{0.140},$$



UNIT HYDROGRAPH MODEL

SCS Dimensionless Unit Hydrograph

- Related to a gamma distribution with shape K=3.77

For this example

- Assume that K=3.77 is close enough in shape to K=3.2 to use without modification.
- A later example will illustrate how to employ a user-specified hydrograph.
- Basin lag time is 0.6*80min = 48 min

(e) Relation between lag and time of concentration

Various researchers (Mockus 1957; Simas 1996) found that for average natural watershed conditions and an approximately uniform distribution of runoff:

$$L = 0.6T_c \qquad \text{(eq. 15–3)}$$

where:
L = lag, h
T_c = time of concentration, h

DATA PREPARATION

HEC-HMS will require us to construct, external to HMS the following:

- *A Hyetograph (rainfall)*
- *Loss model parameters*
- *Transform model parameters*

Now ready to build the HEC-HMS model.

HEC-HMS

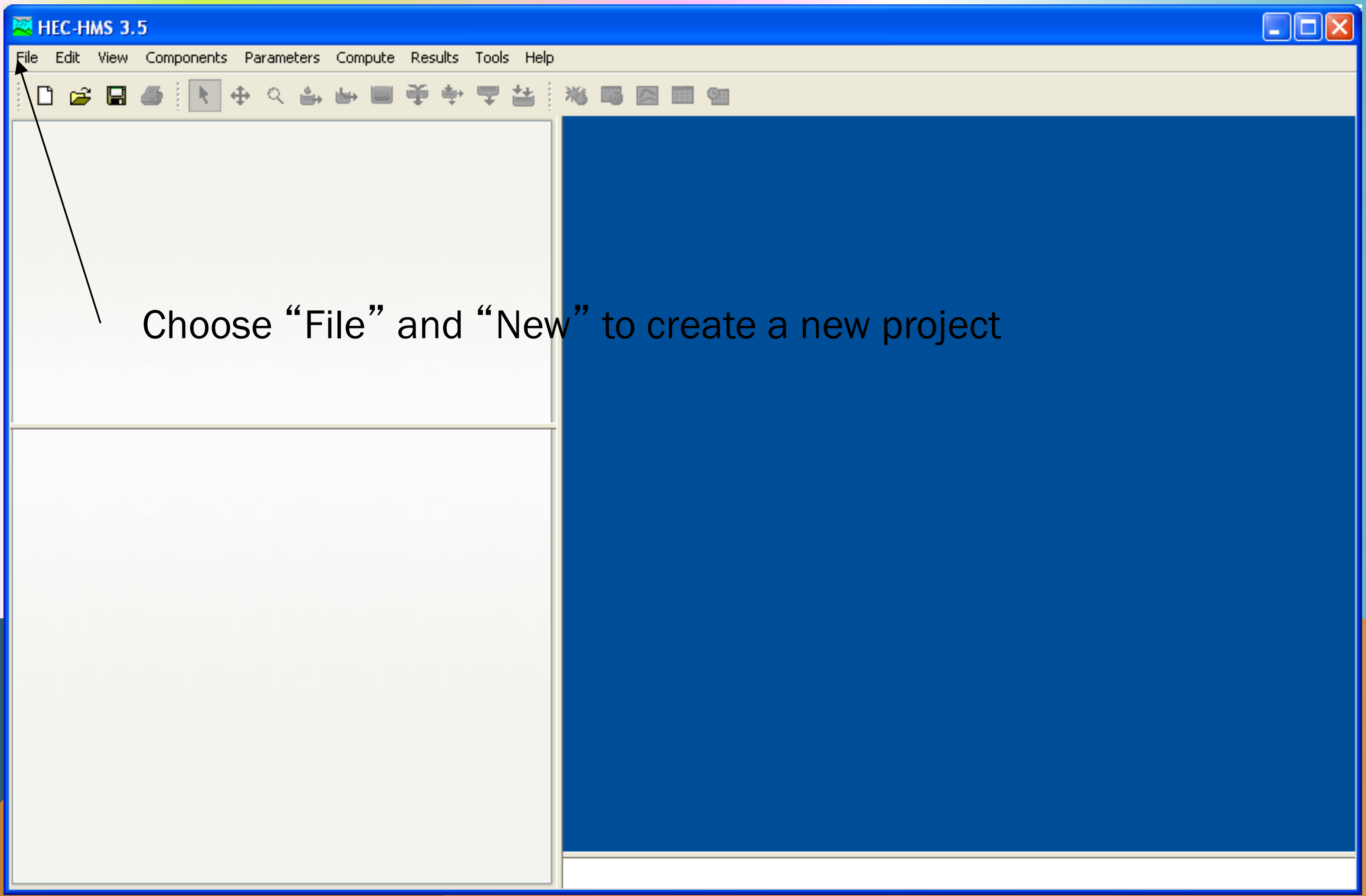
Start the program

Create a project

- Project is a directory where all data are stored for a particular model.
- Can share files between projects, but an advanced technique.

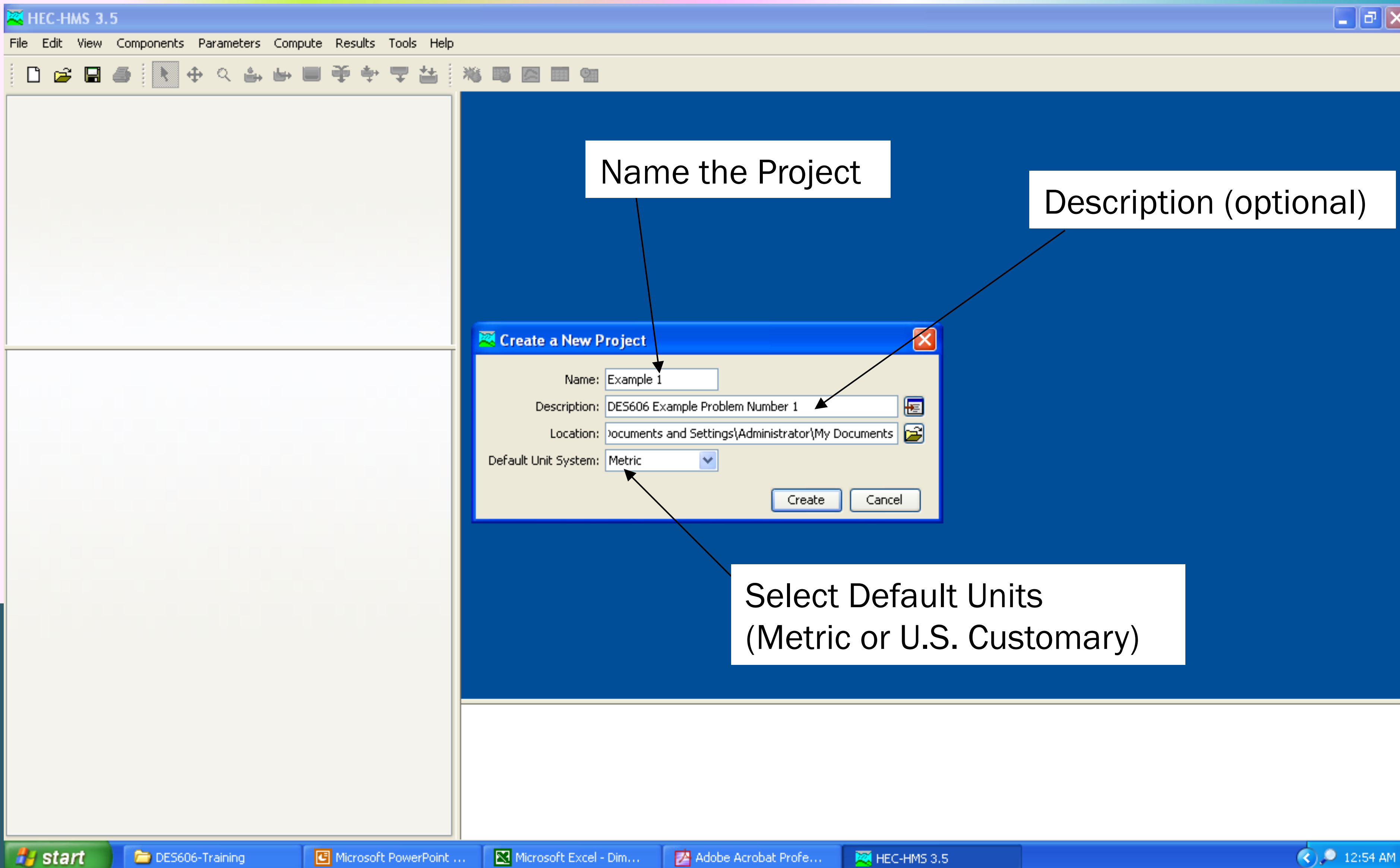
HEC-HMS

Start the program

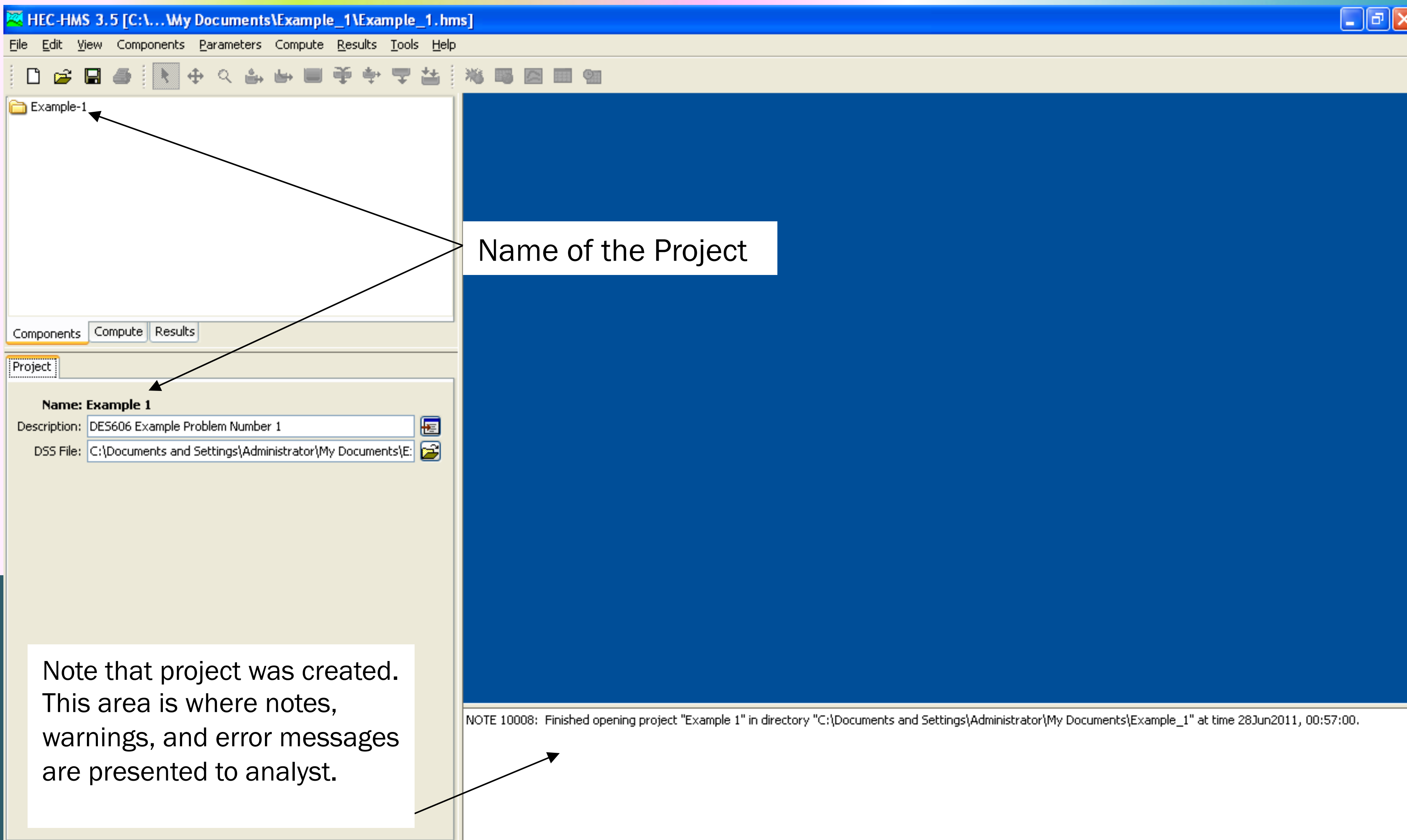


Choose “File” and “New” to create a new project

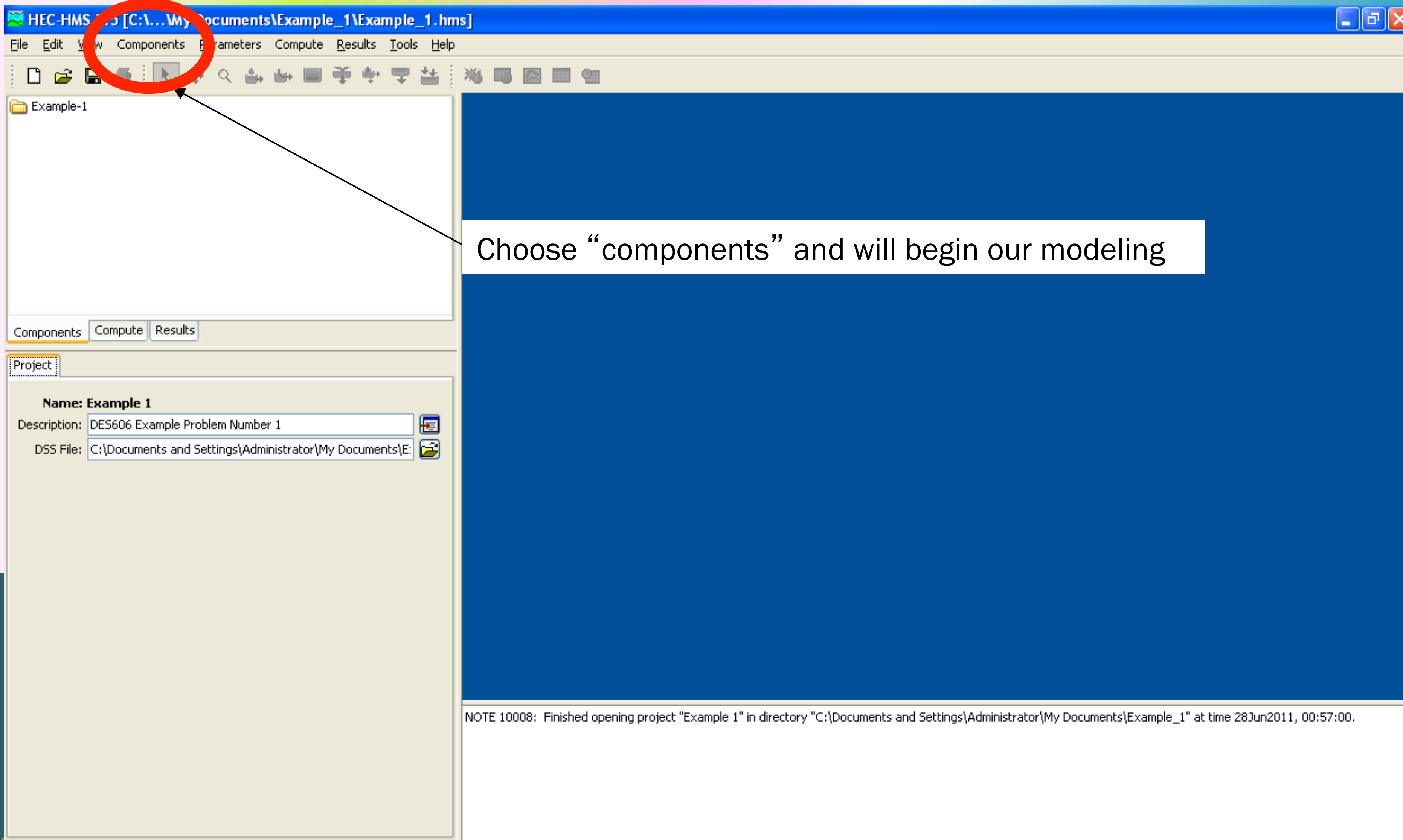
CREATE PROJECT



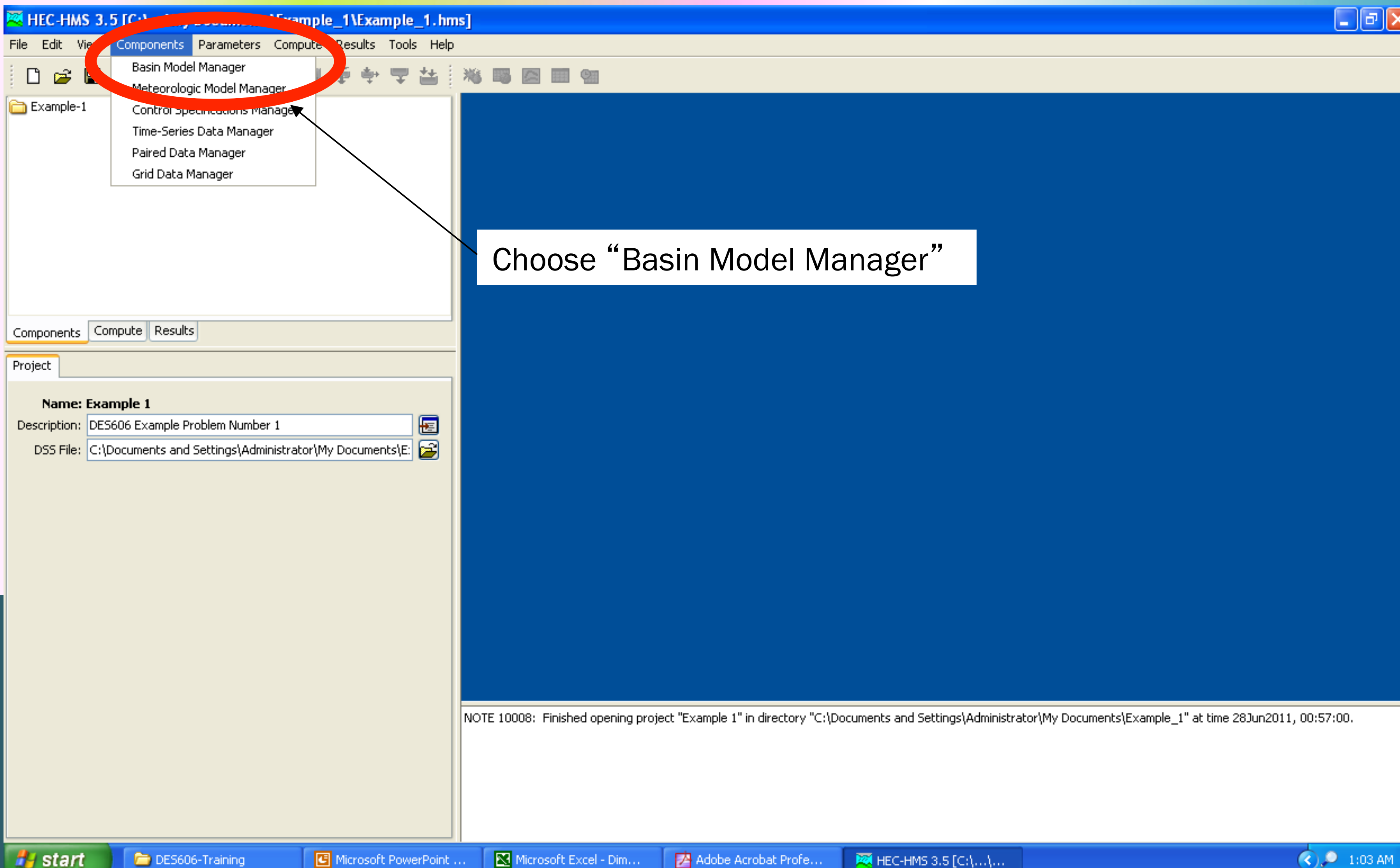
CREATE PROJECT



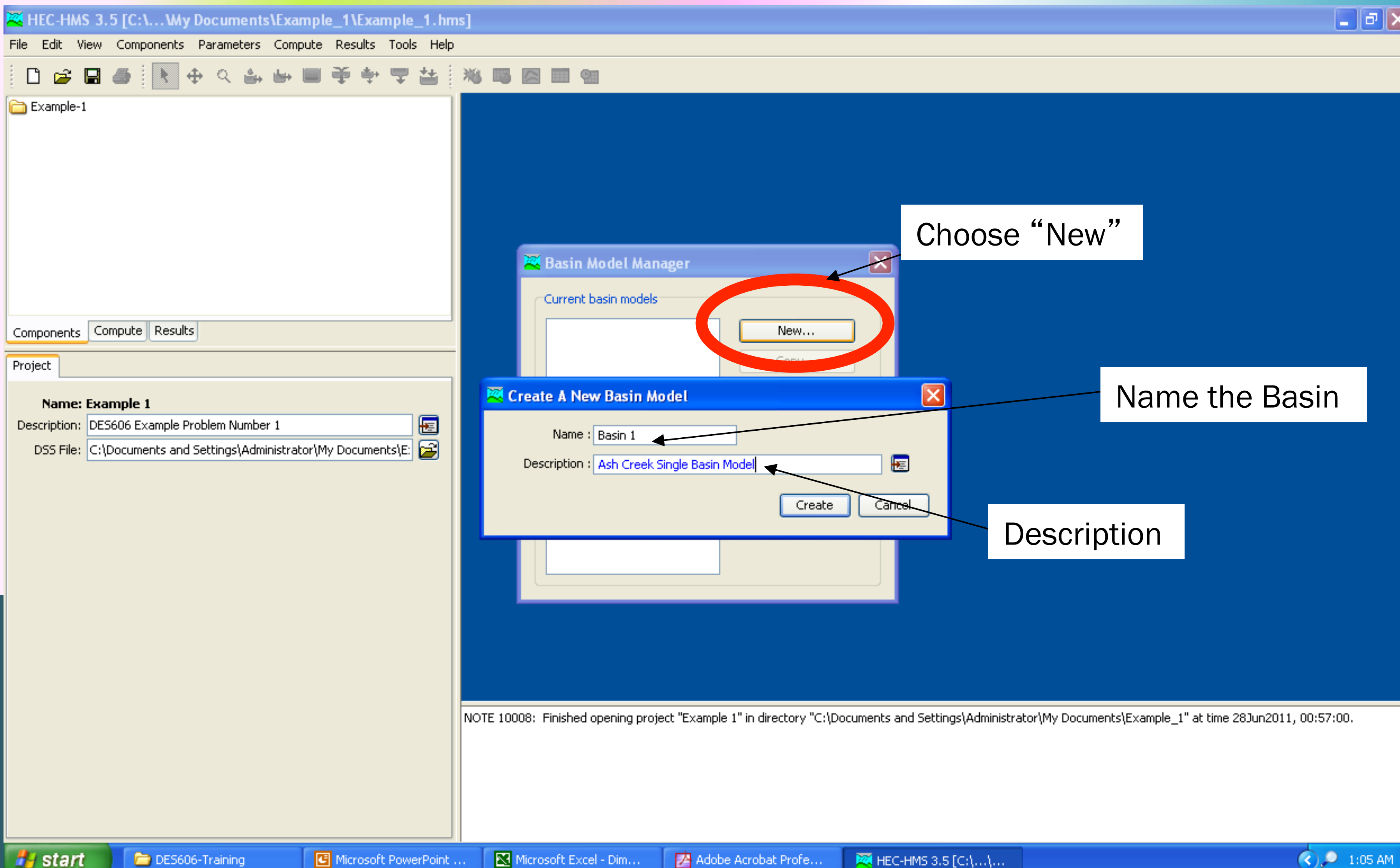
CREATE BASIN MODEL



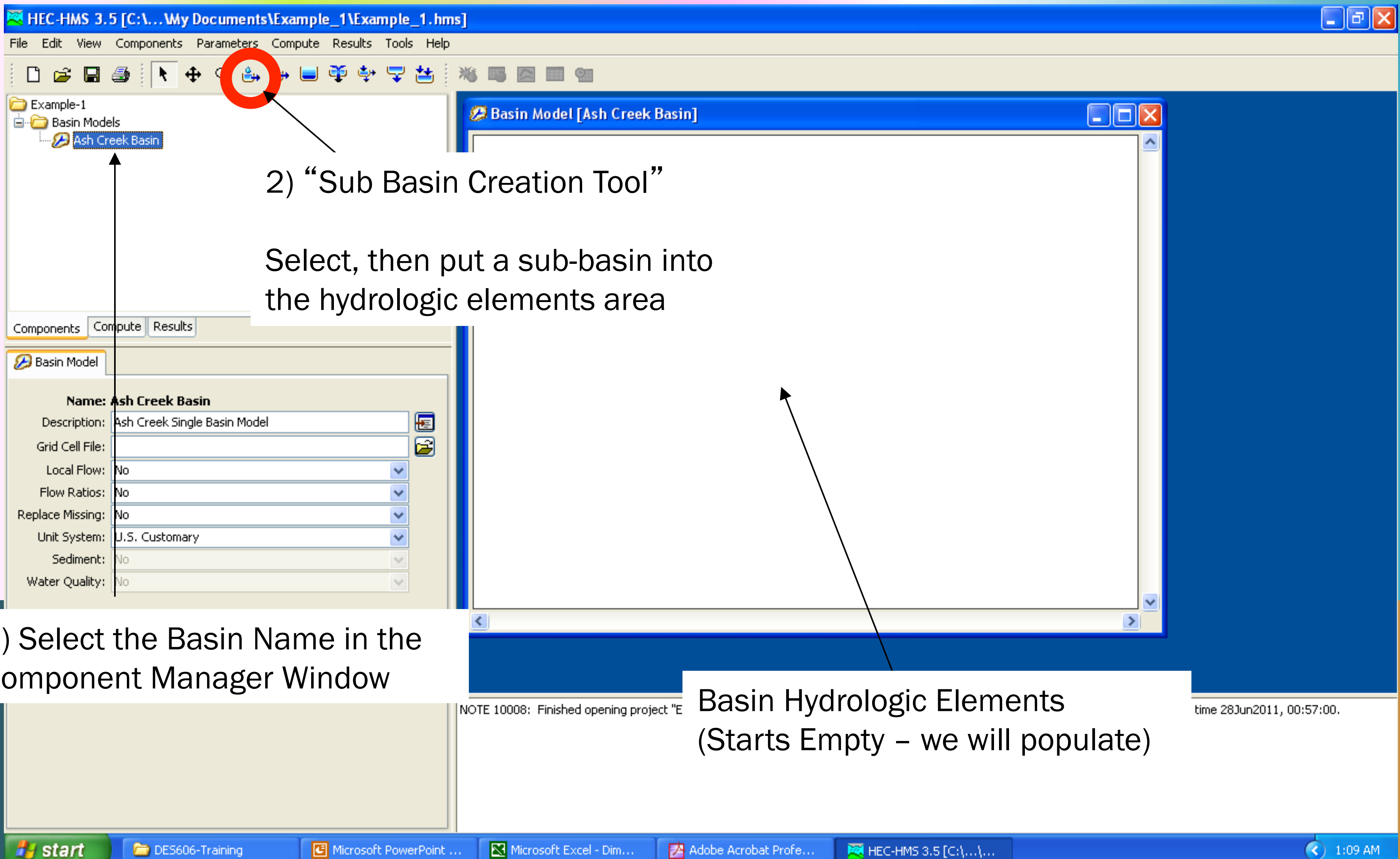
CREATE BASIN MODEL



CREATE BASIN MODEL



CREATE BASIN MODEL



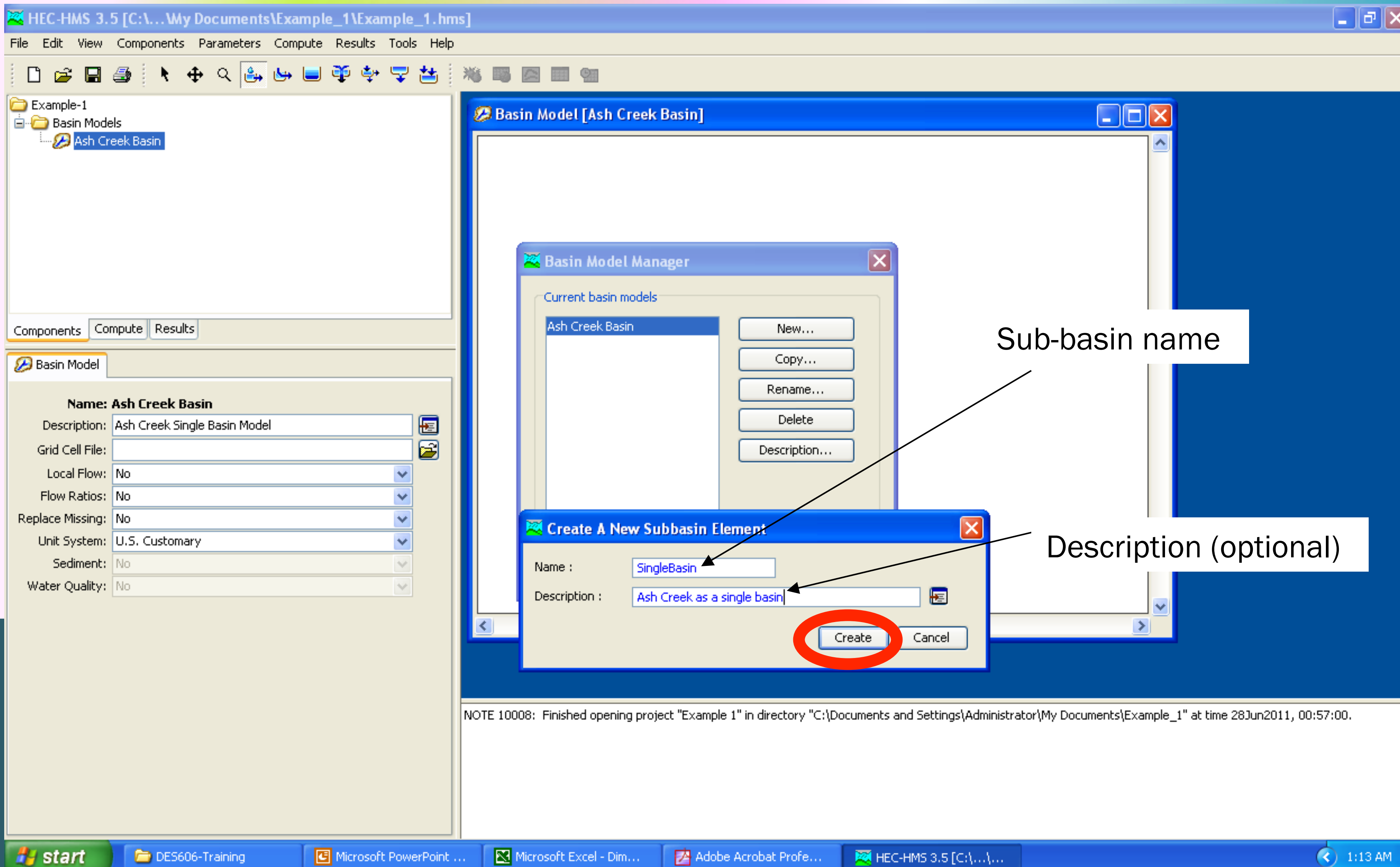
2) "Sub Basin Creation Tool"

Select, then put a sub-basin into the hydrologic elements area

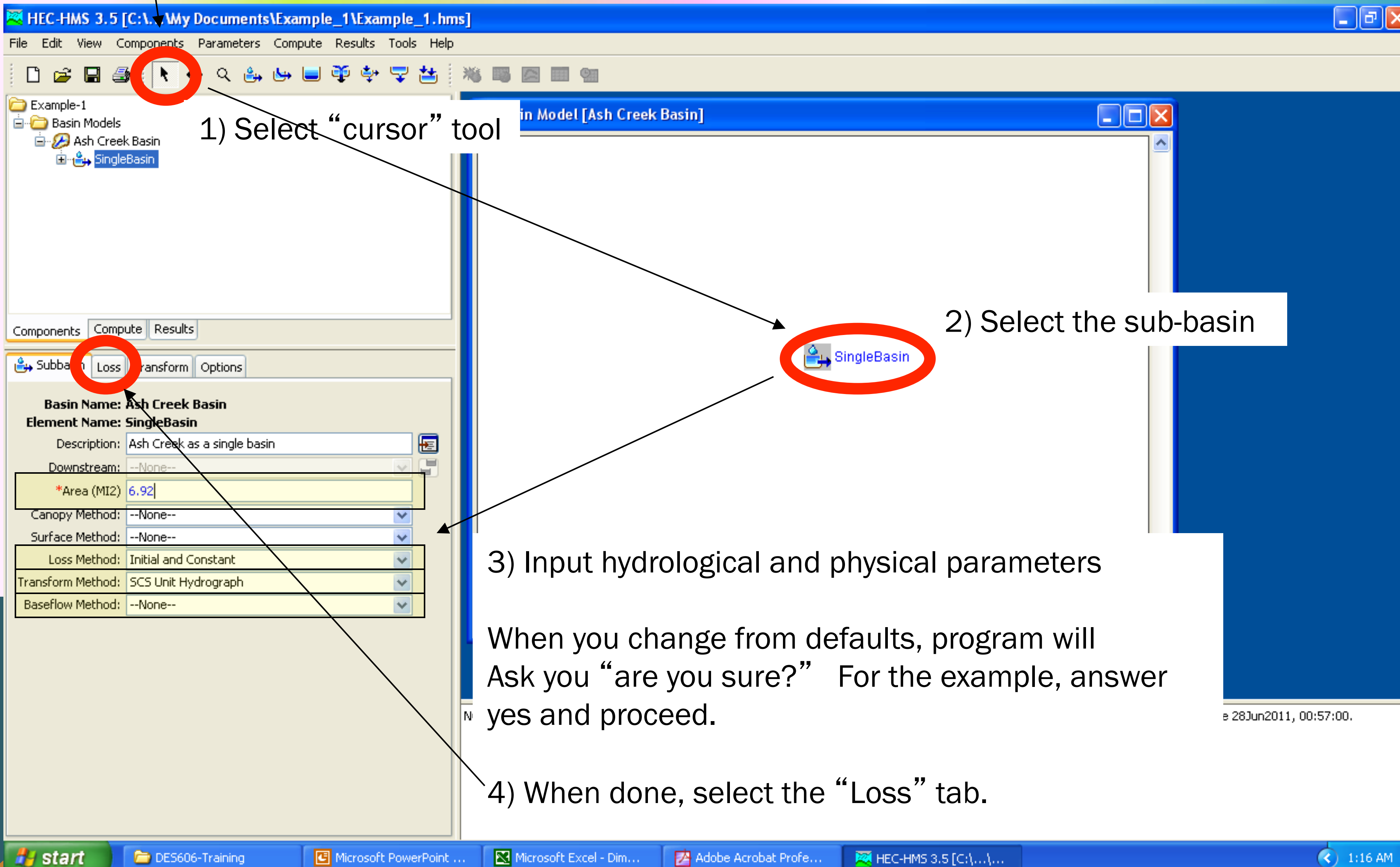
1) Select the Basin Name in the Component Manager Window

Basin Hydrologic Elements (Starts Empty – we will populate)

CREATE BASIN MODEL



BASIN MODEL DATA INPUT



1) Select "cursor" tool

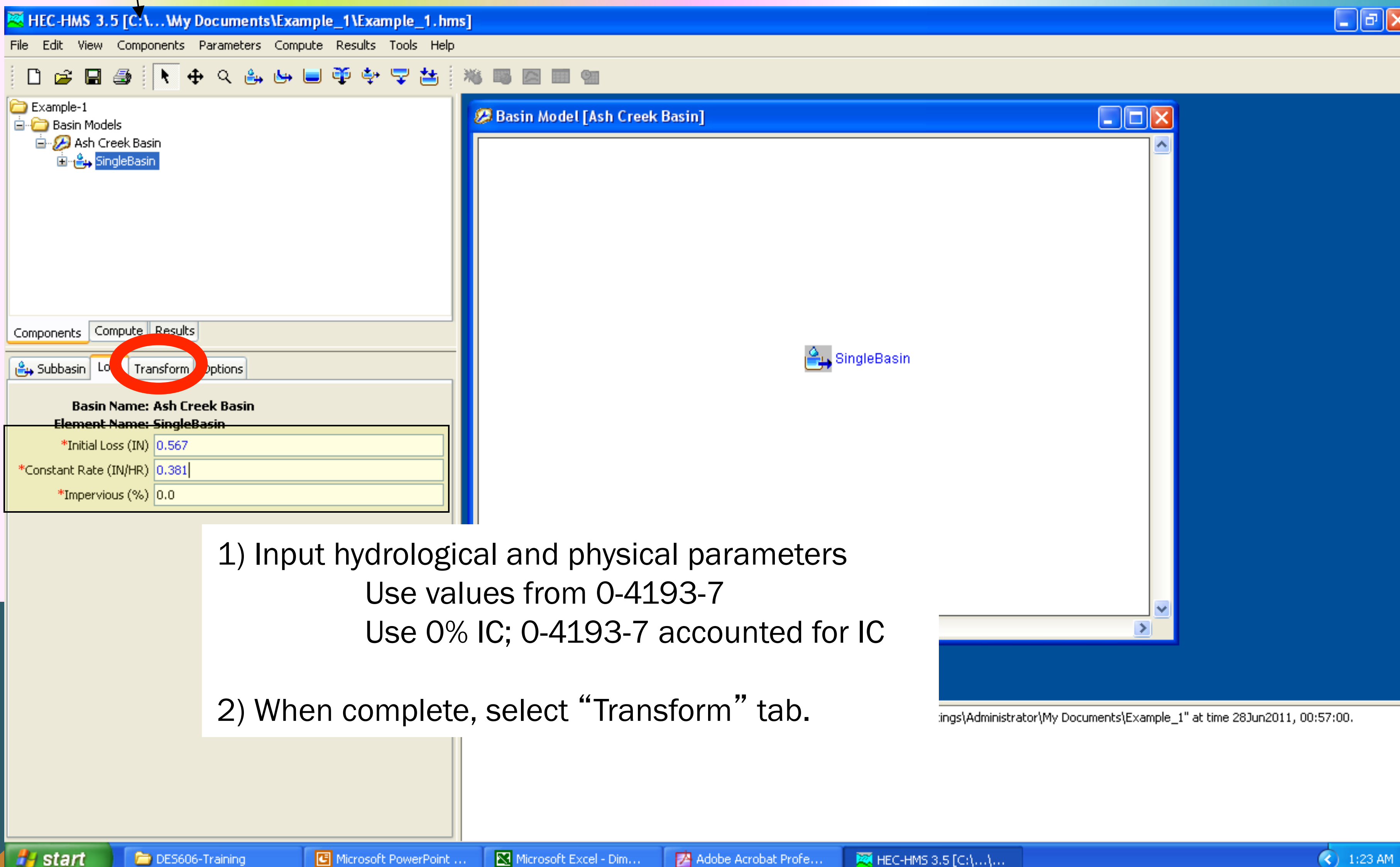
2) Select the sub-basin

3) Input hydrological and physical parameters

When you change from defaults, program will Ask you "are you sure?" For the example, answer yes and proceed.

4) When done, select the "Loss" tab.

BASIN MODEL DATA INPUT



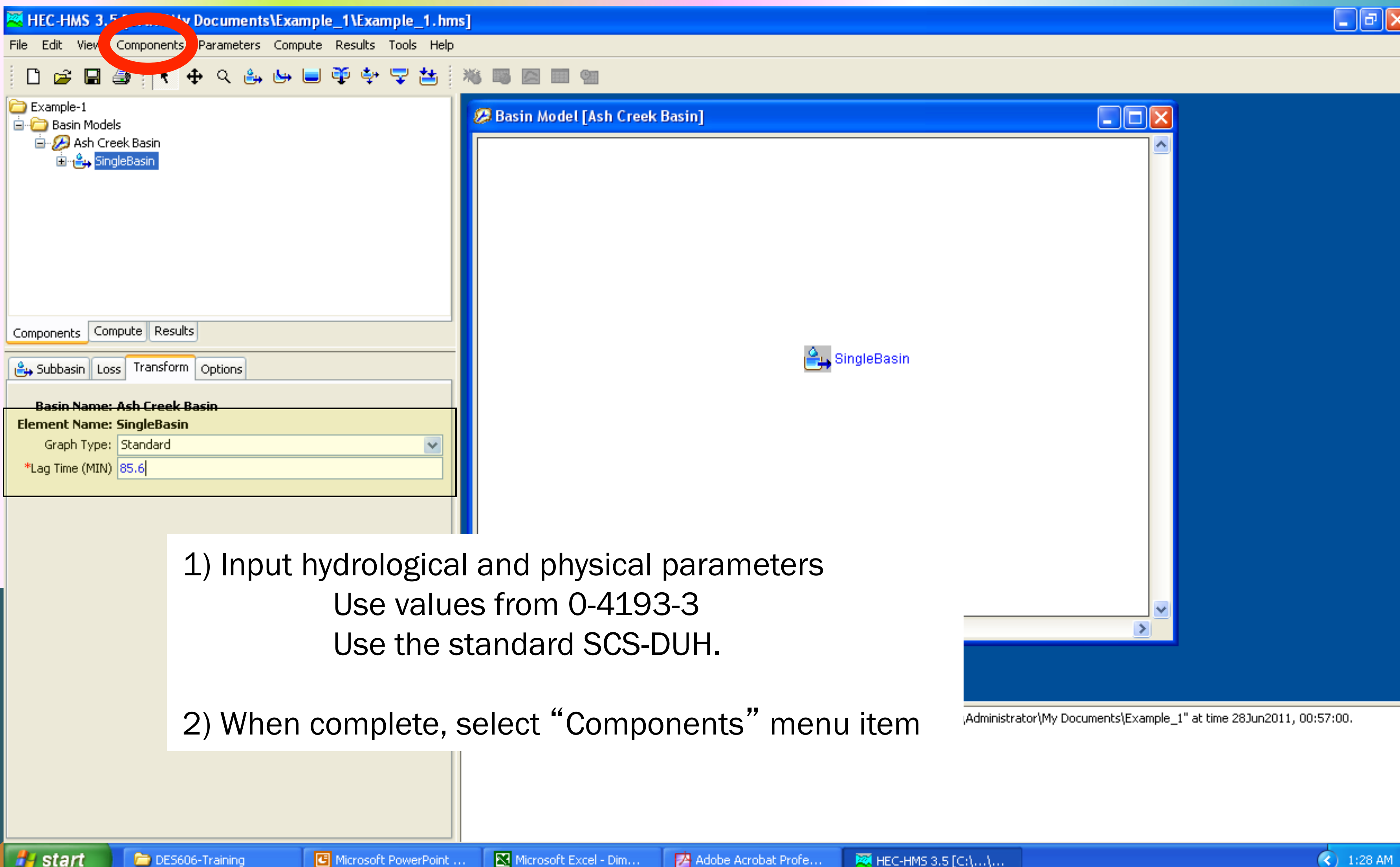
1) Input hydrological and physical parameters

Use values from 0-4193-7

Use 0% IC; 0-4193-7 accounted for IC

2) When complete, select “Transform” tab.

BASIN MODEL DATA INPUT



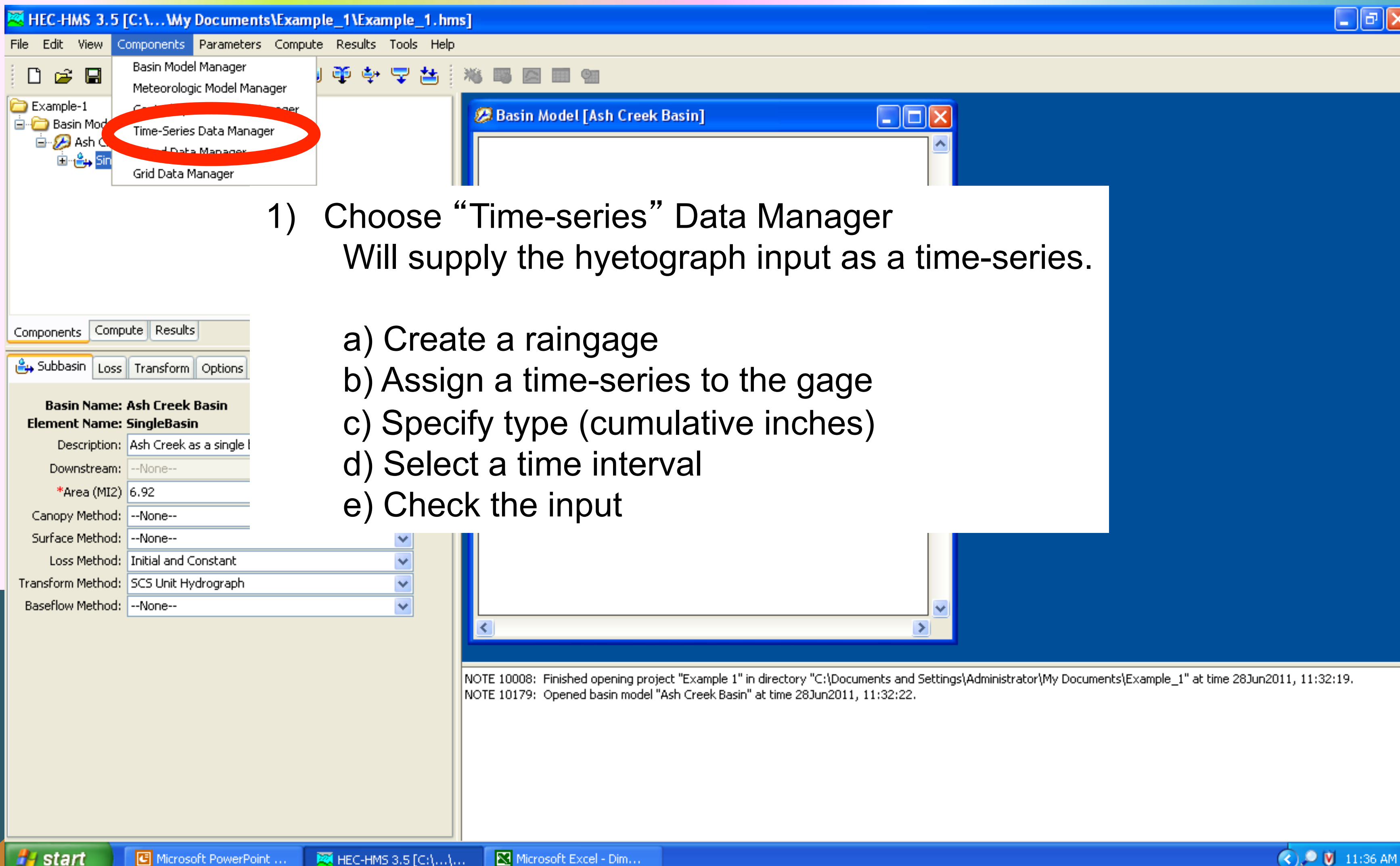
1) Input hydrological and physical parameters

Use values from 0-4193-3

Use the standard SCS-DUH.

2) When complete, select “Components” menu item

CREATE RAINFALL INPUT



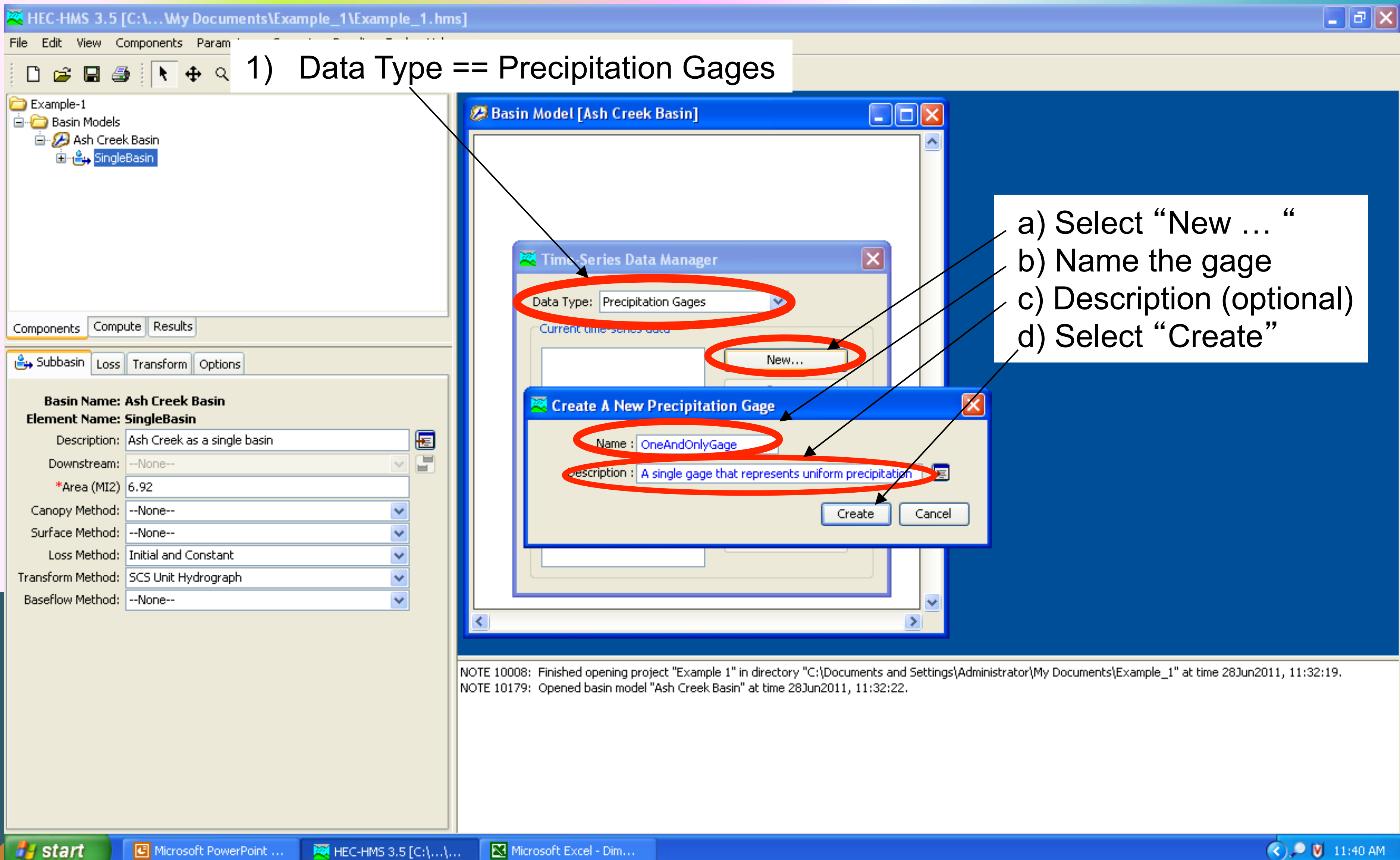
1) Choose "Time-series" Data Manager
Will supply the hyetograph input as a time-series.

a) Create a raingage
b) Assign a time-series to the gage
c) Specify type (cumulative inches)
d) Select a time interval
e) Check the input

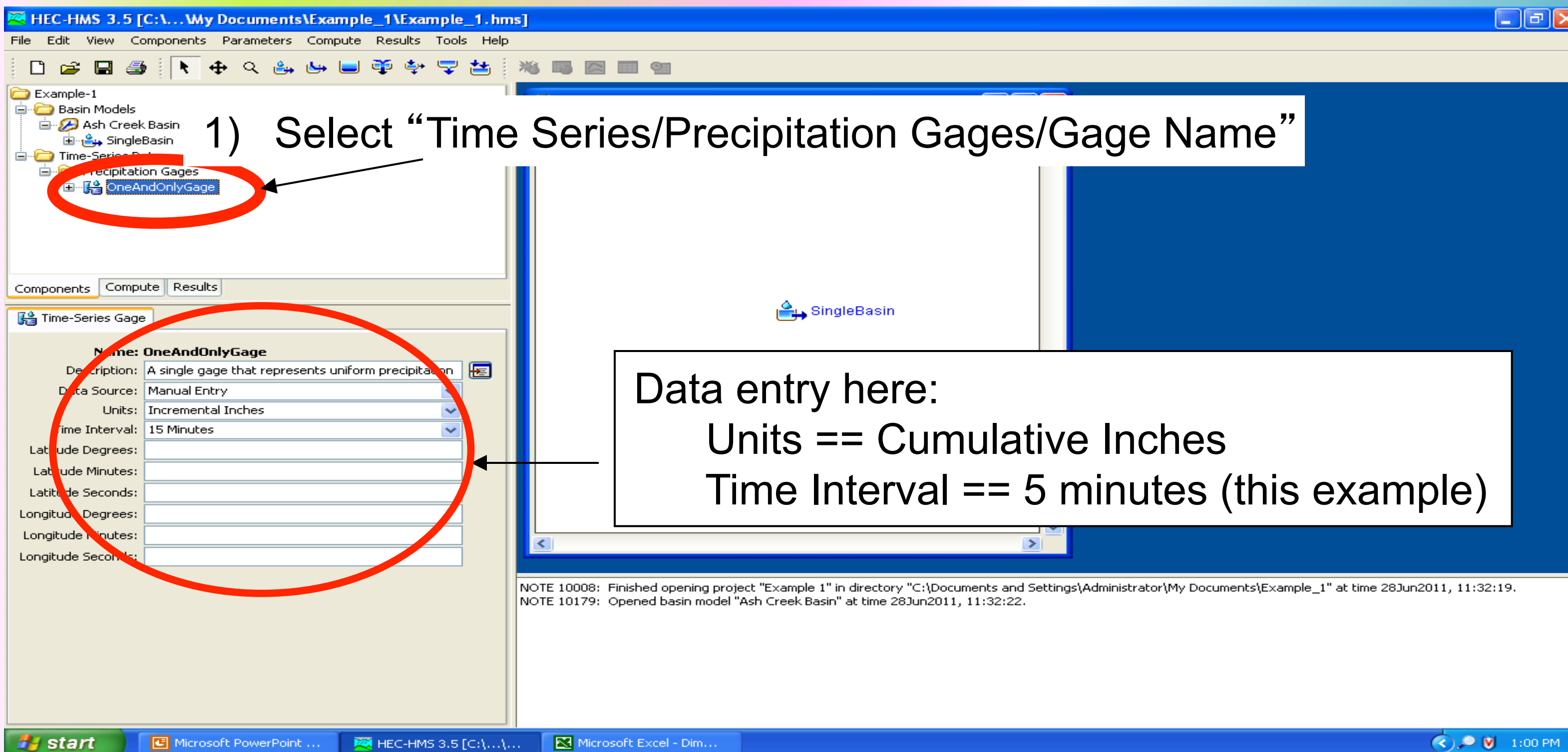
CREATE RAINFALL INPUT

1) Data Type == Precipitation Gages

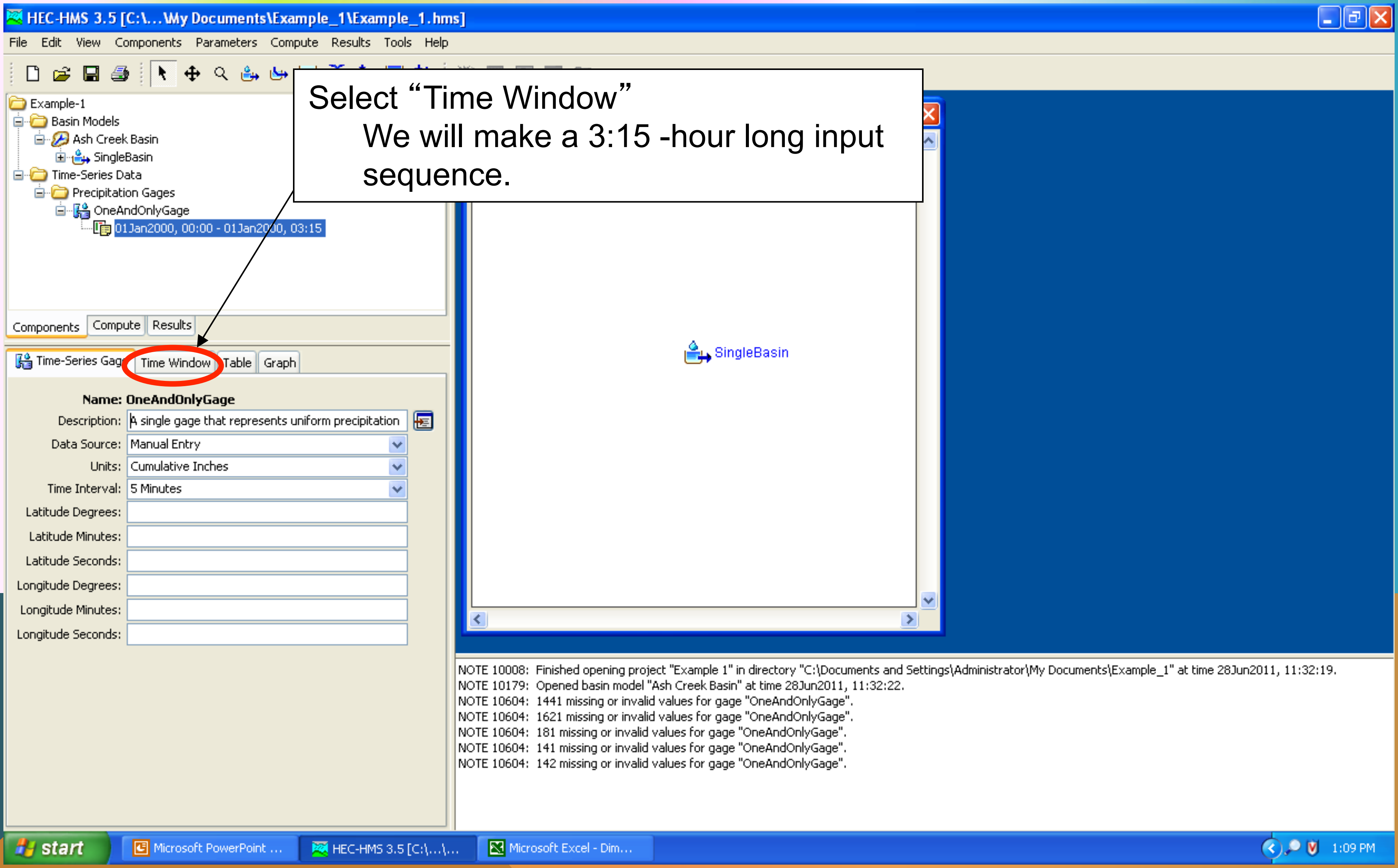
a) Select “New … “
b) Name the gage
c) Description (optional)
d) Select “Create”



CREATE RAINFALL INPUT



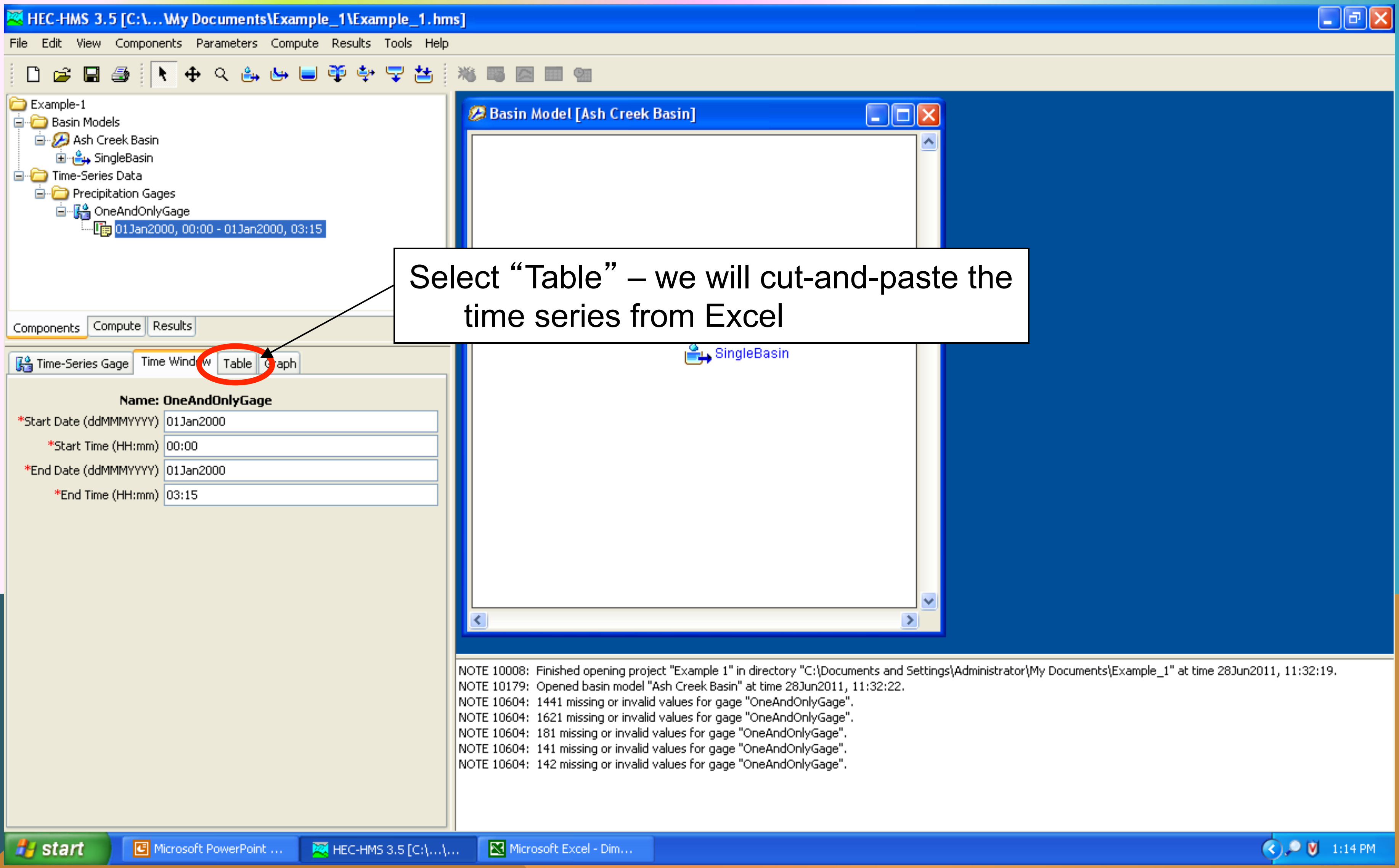
CREATE RAINFALL INPUT



Select "Time Window"

We will make a 3:15 -hour long input sequence.

CREATE RAINFALL INPUT

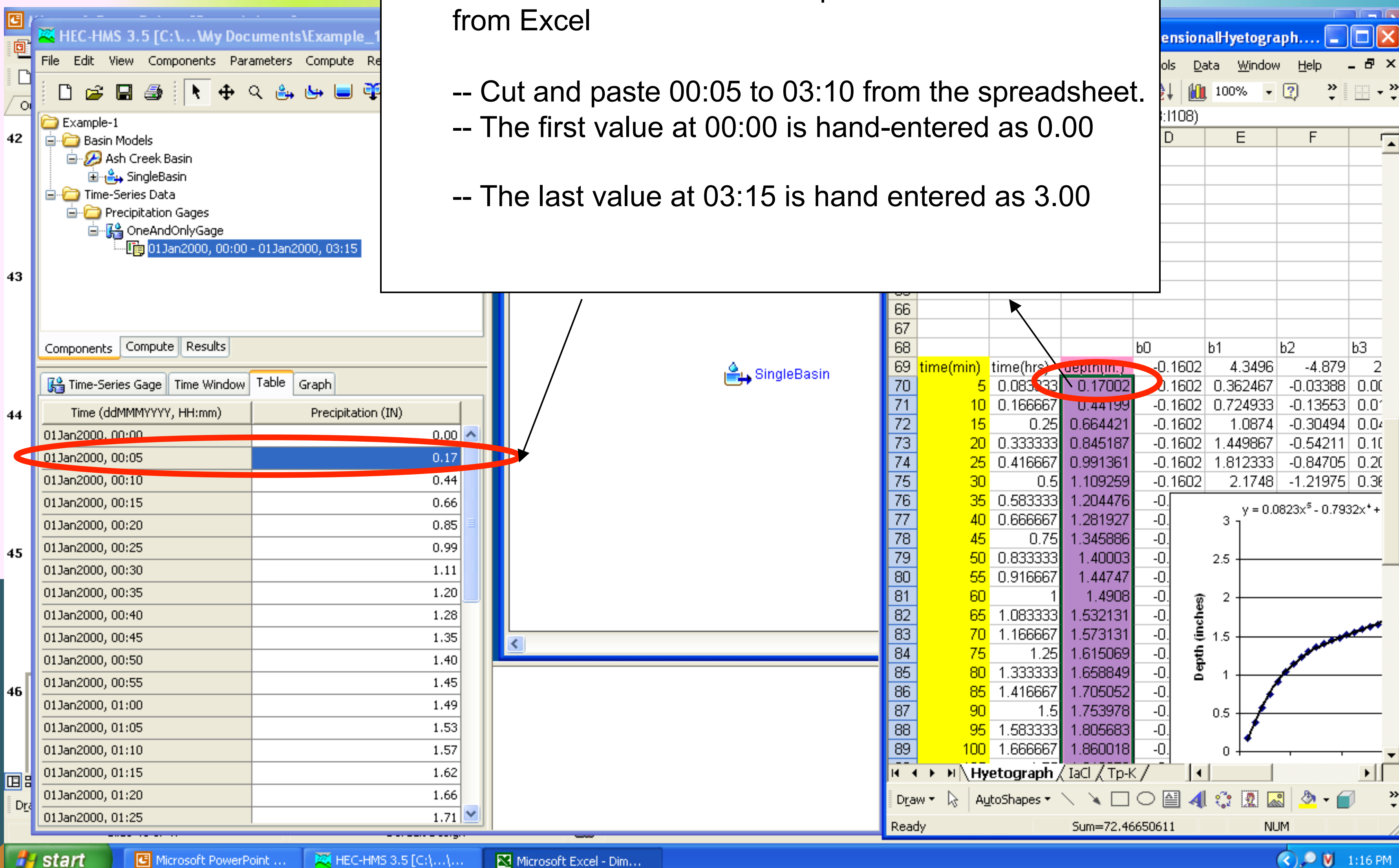


CREATE RAINFALL INPUT

Select “Table” – we will cut-and-paste the time series from Excel

-- Cut and paste 00:05 to 03:10 from the spreadsheet.
-- The first value at 00:00 is hand-entered as 0.00

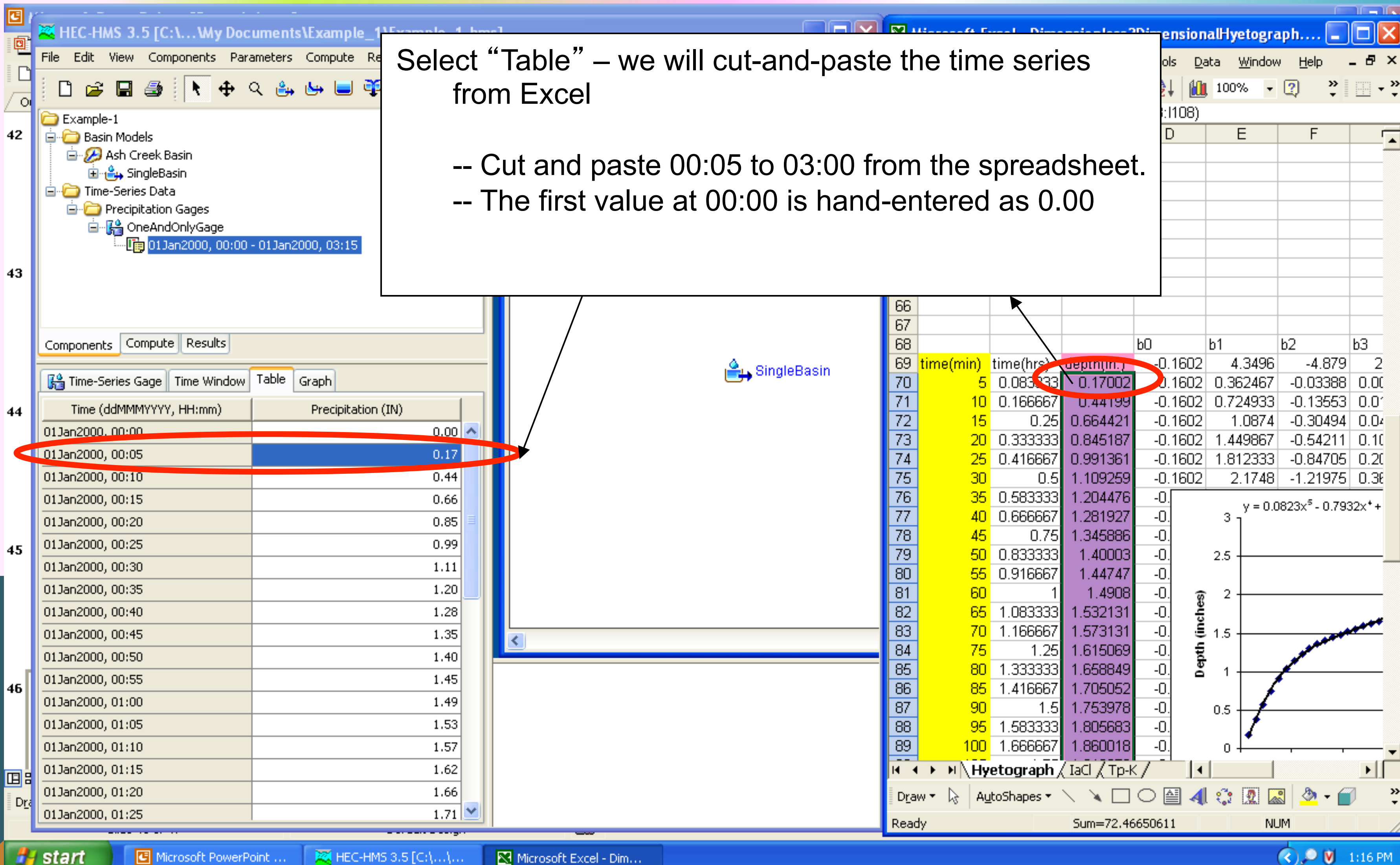
-- The last value at 03:15 is hand entered as 3.00



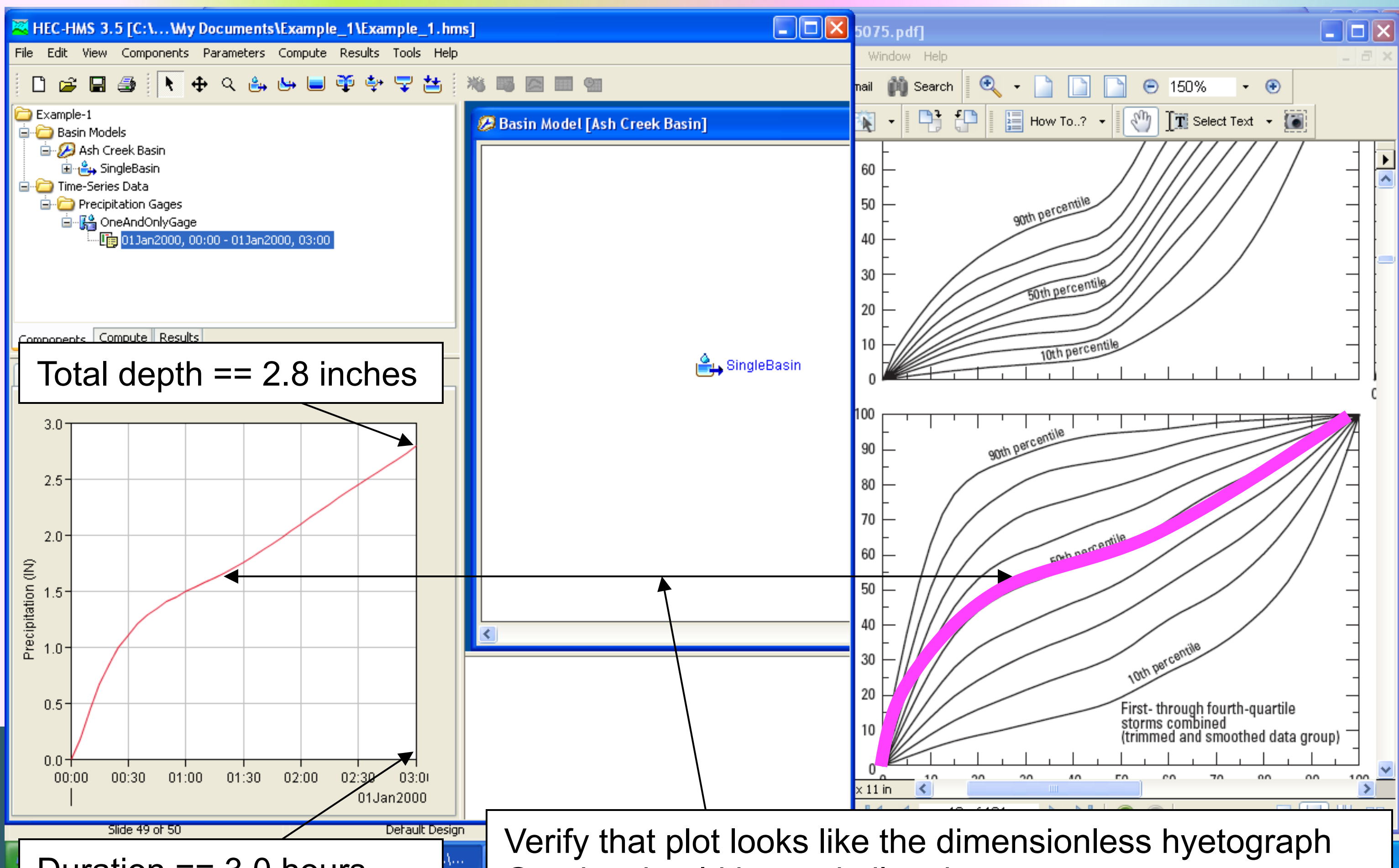
CREATE RAINFALL INPUT

Select “Table” – we will cut-and-paste the time series from Excel

-- Cut and paste 00:05 to 03:00 from the spreadsheet.
-- The first value at 00:00 is hand-entered as 0.00



CREATE RAINFALL INPUT

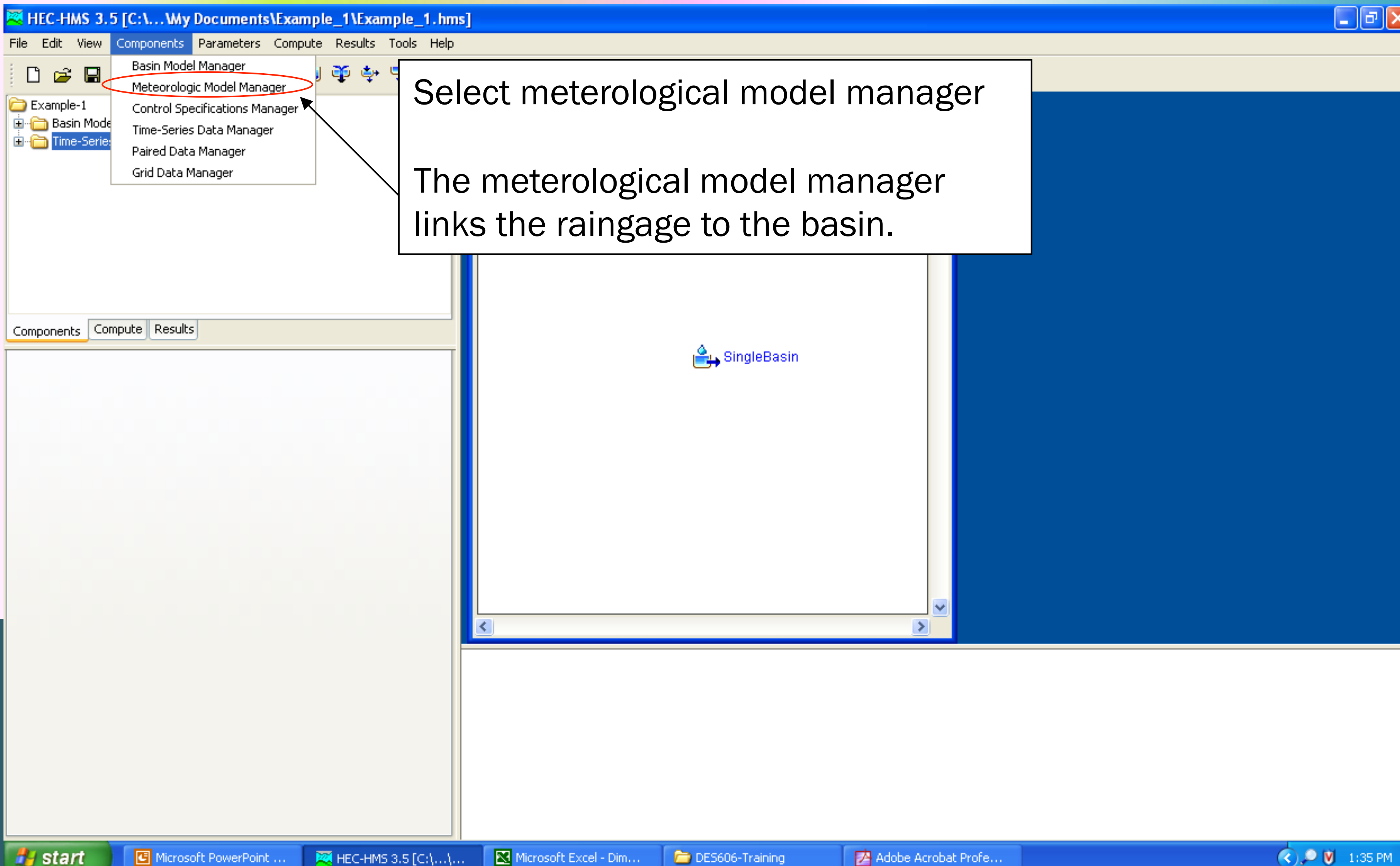


Total depth == 2.8 inches

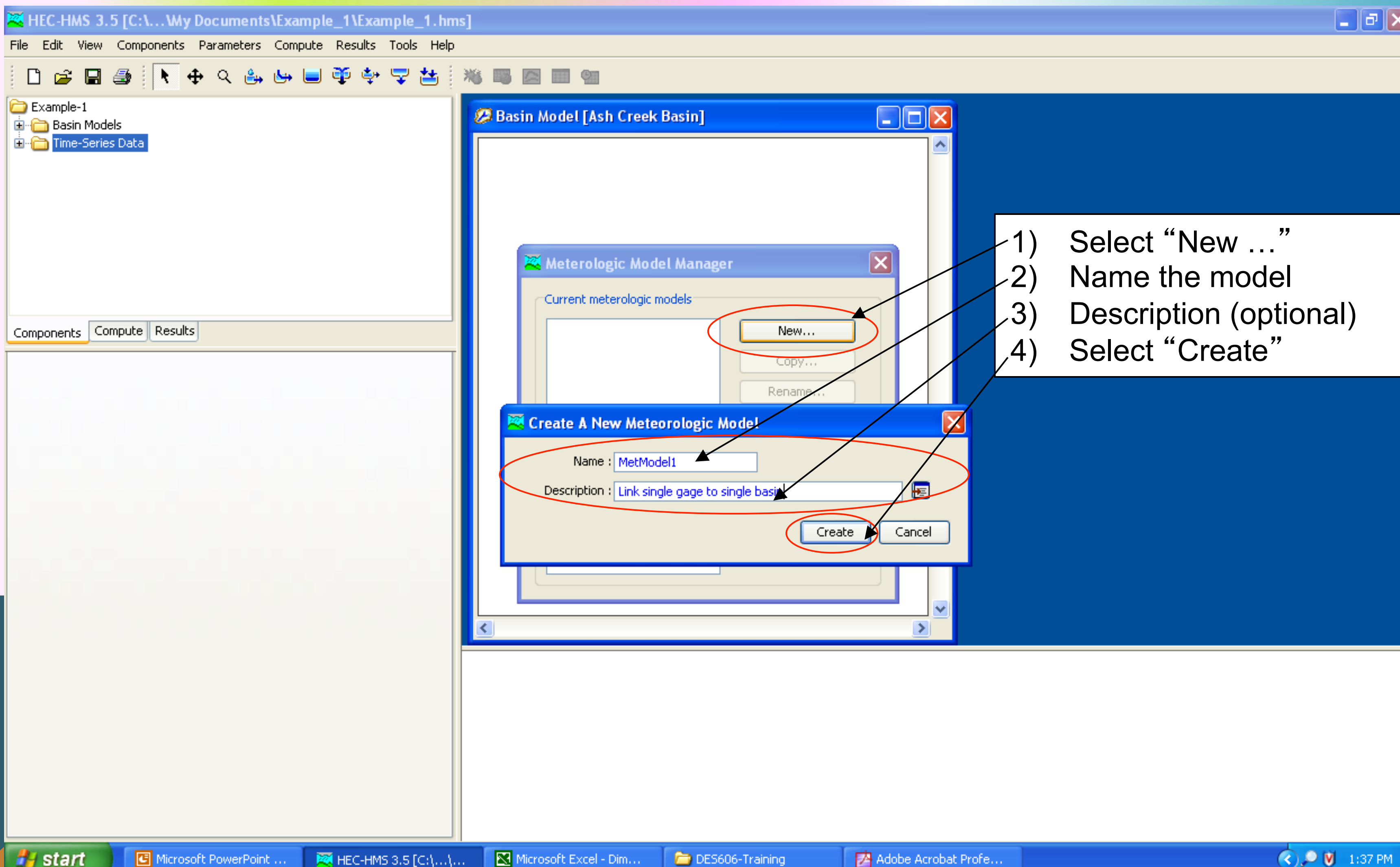
Duration == 3.0 hours

Verify that plot looks like the dimensionless hyetograph
Graphs should have similar shape

CREATE METEROLOGICAL MODEL

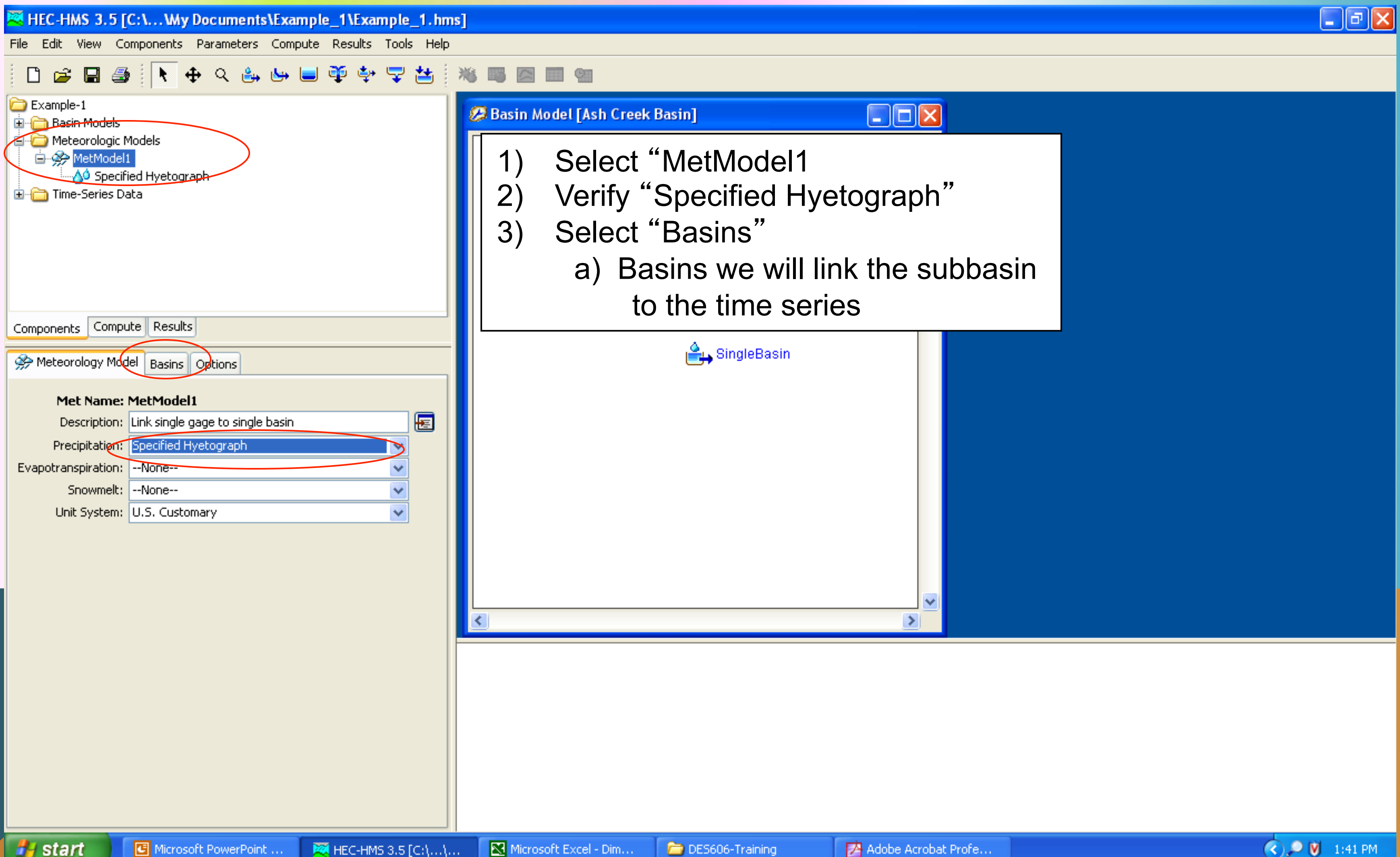


CREATE METEROLOGICAL MODEL



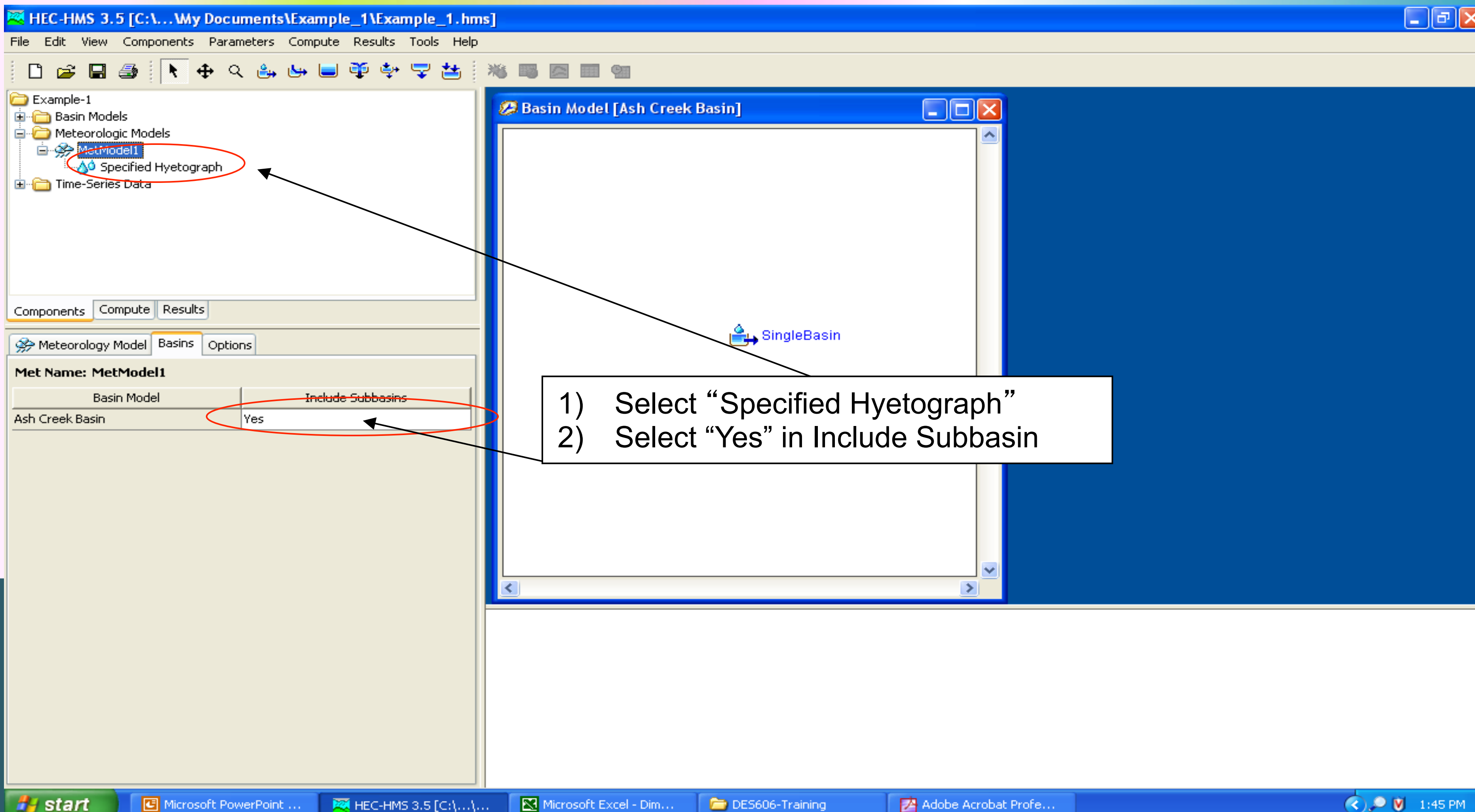
1) Select “New …”
2) Name the model
3) Description (optional)
4) Select “Create”

CREATE METEROLOGICAL MODEL

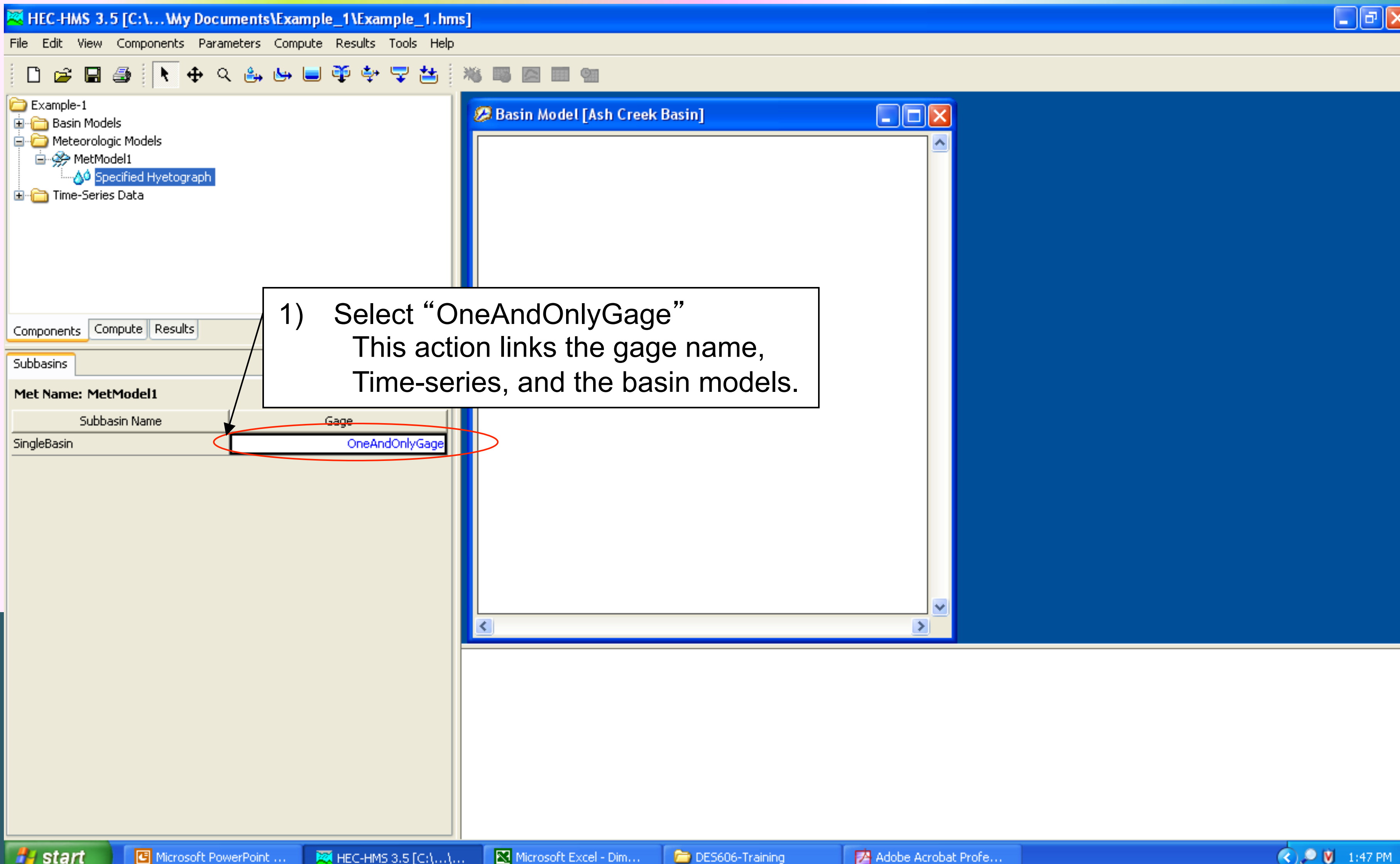


1) Select "MetModel1
2) Verify "Specified Hyetograph"
3) Select "Basins"
   a) Basins we will link the subbasin to the time series

CREATE METEROLOGICAL MODEL

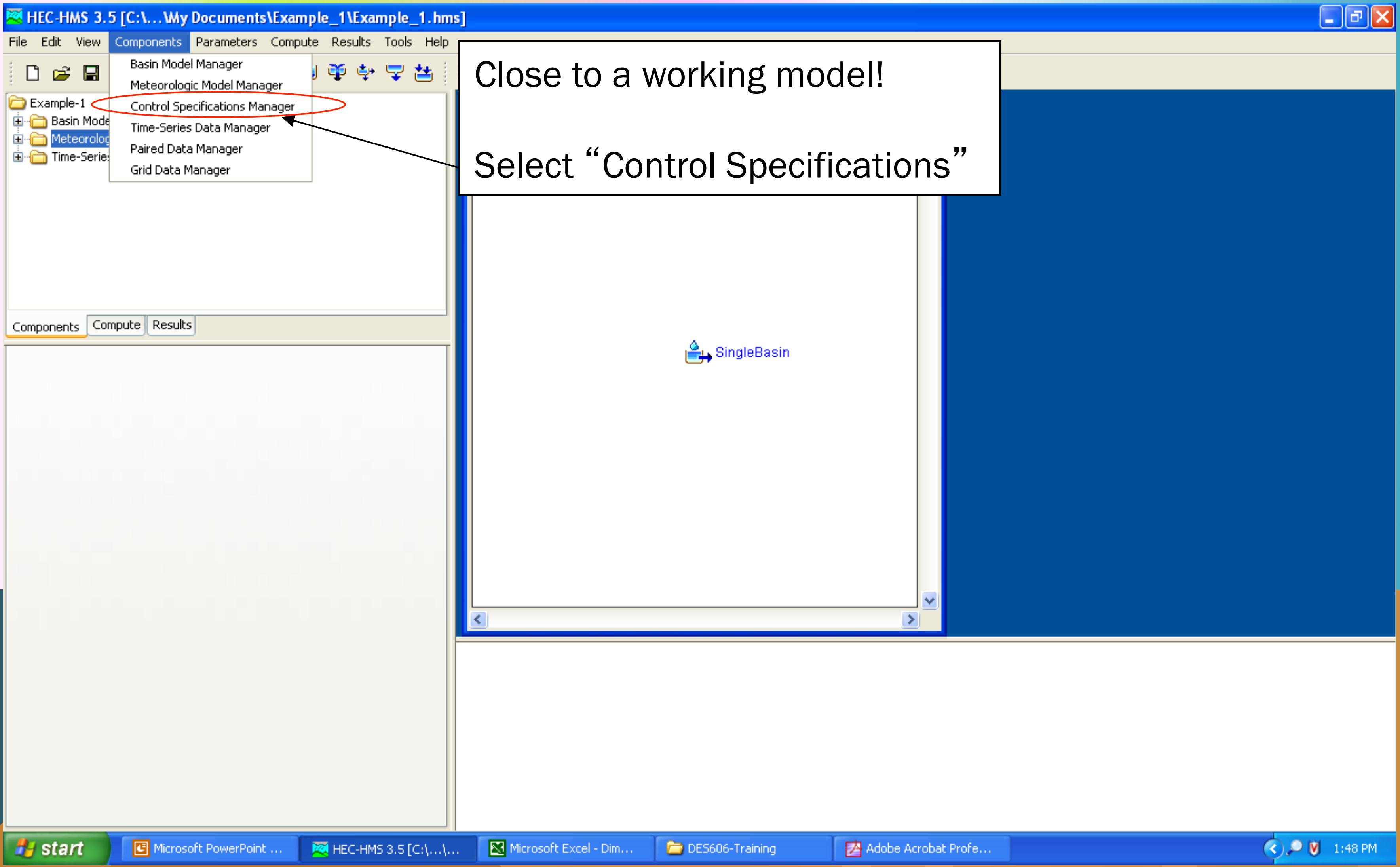


CREATE METEROLOGICAL MODEL



1) Select “OneAndOnlyGage”
This action links the gage name, Time-series, and the basin models.

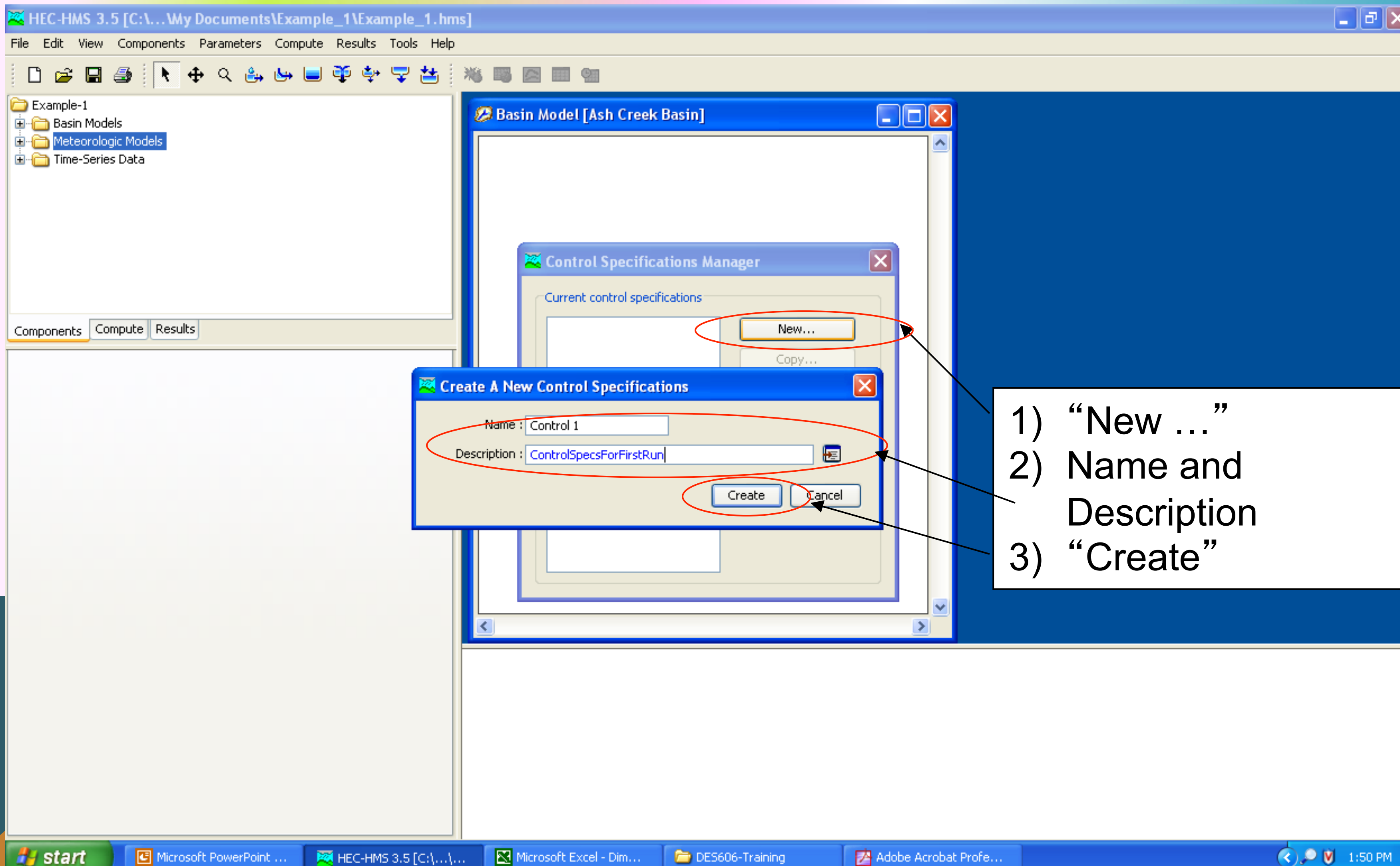
CREATE CONTROL SPECIFICATIONS



Close to a working model!

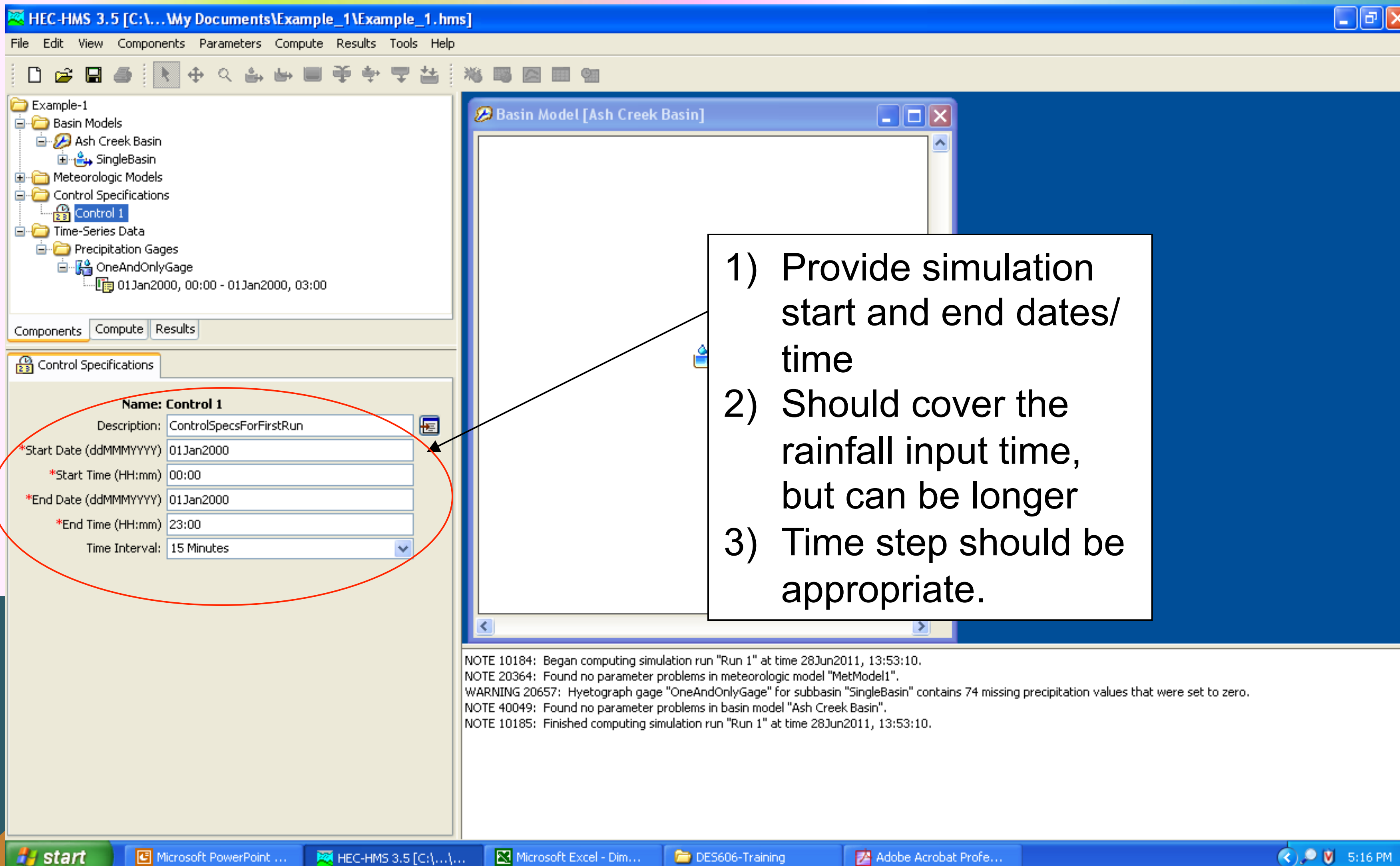
Select “Control Specifications”

CREATE CONTROL SPECIFICATIONS



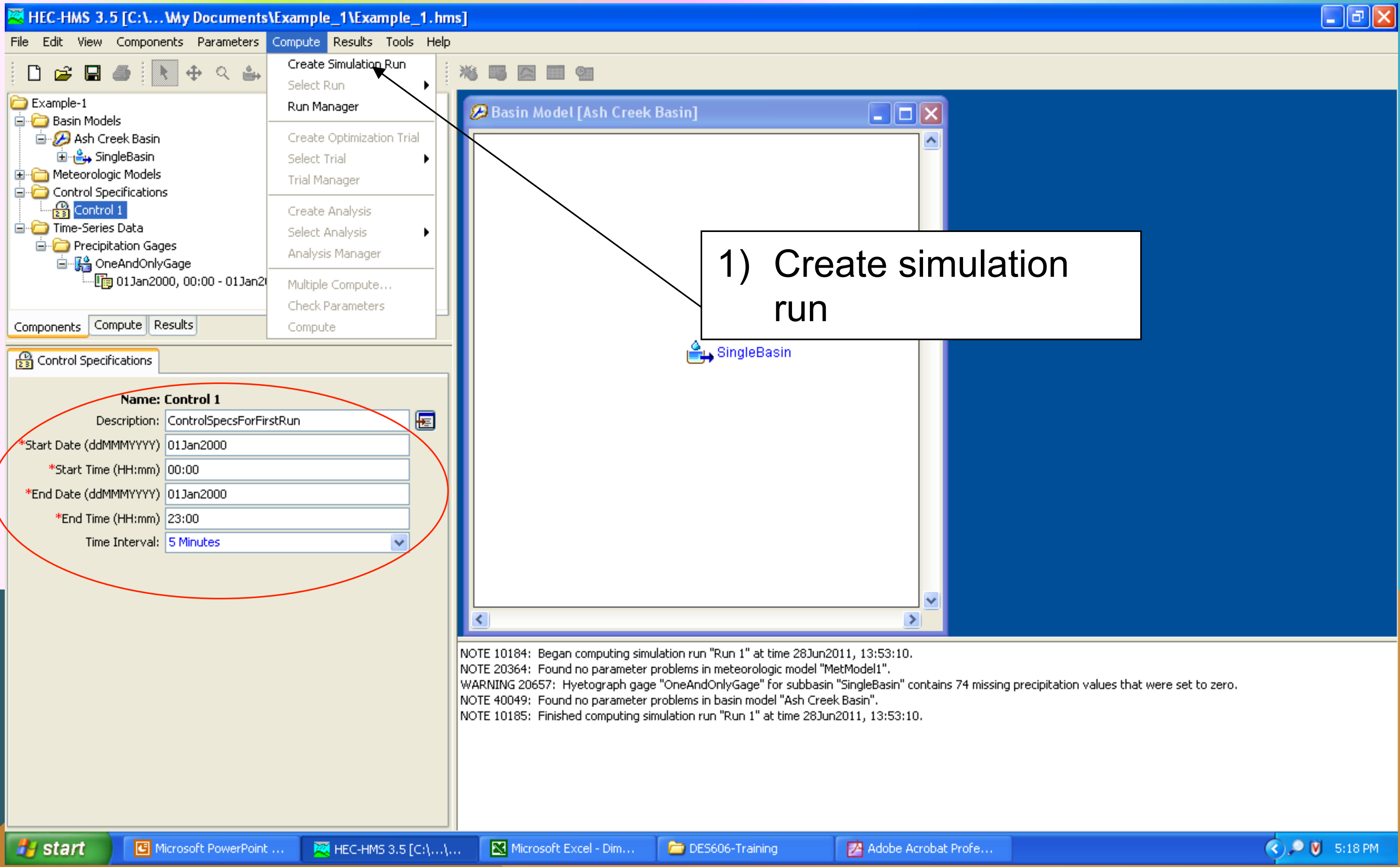
1) "New …"
2) Name and Description
3) "Create"

CREATE CONTROL SPECIFICATIONS

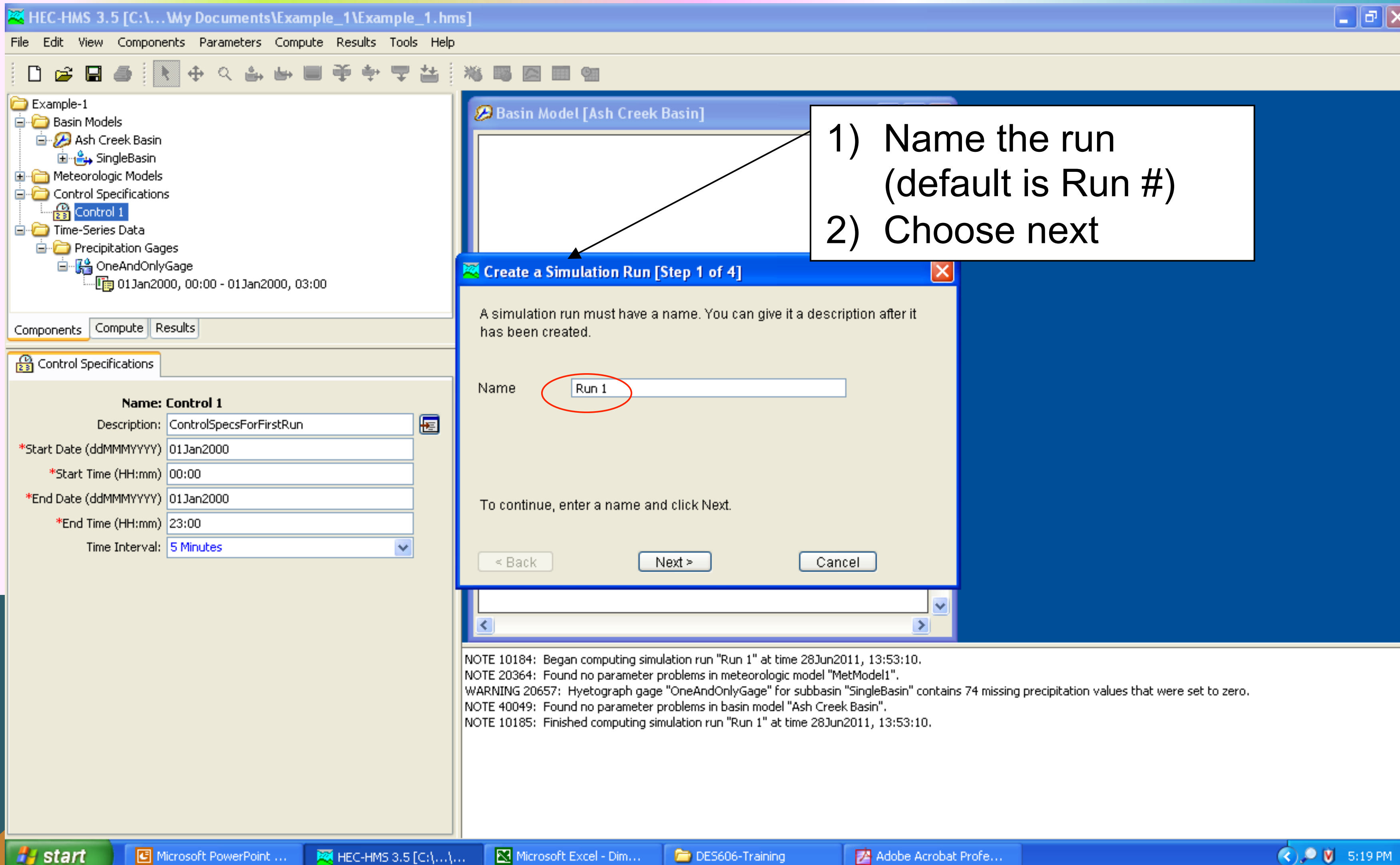


1) Provide simulation start and end dates/ time
2) Should cover the rainfall input time, but can be longer
3) Time step should be appropriate.

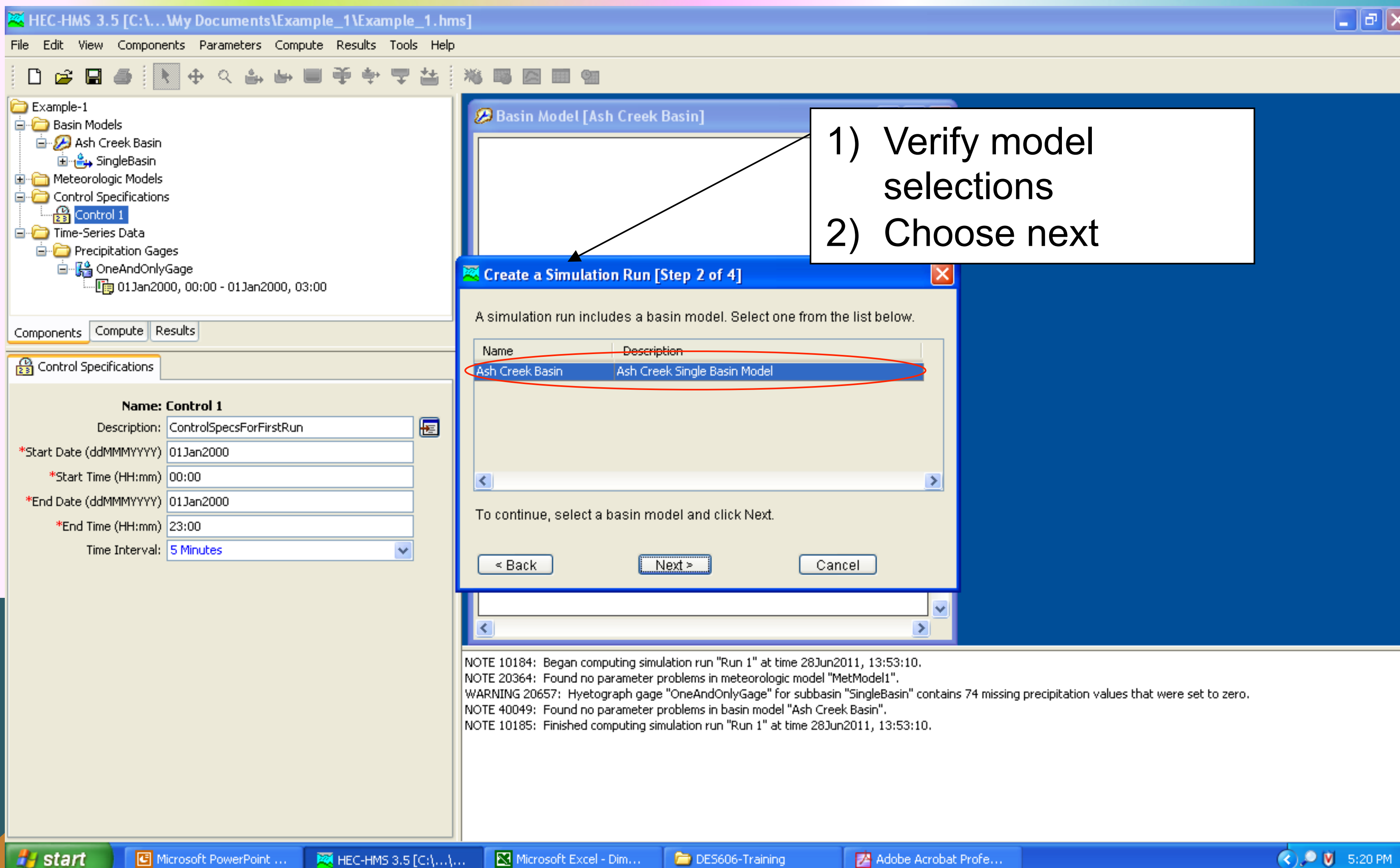
CREATE SIMULATION



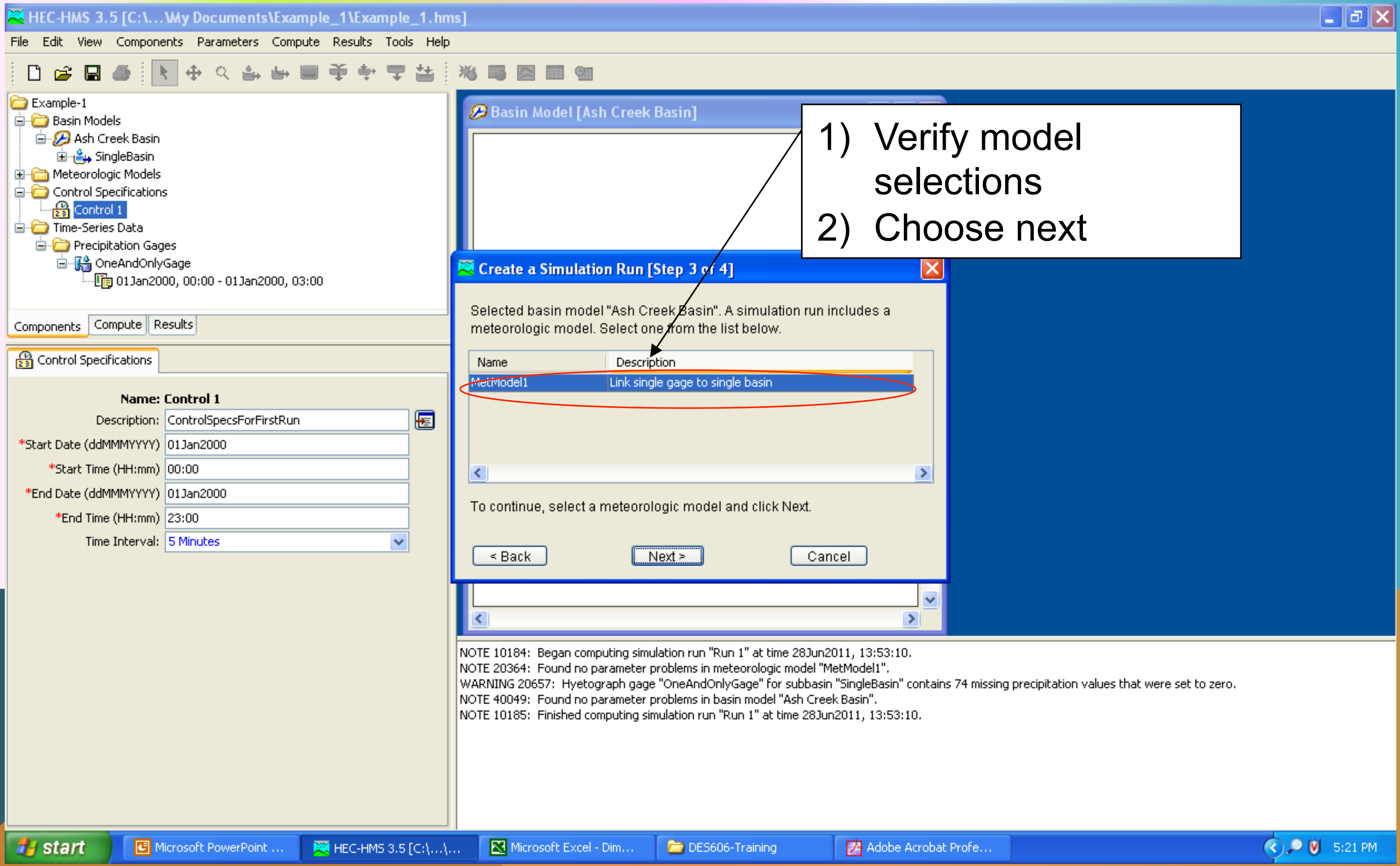
CREATE SIMULATION



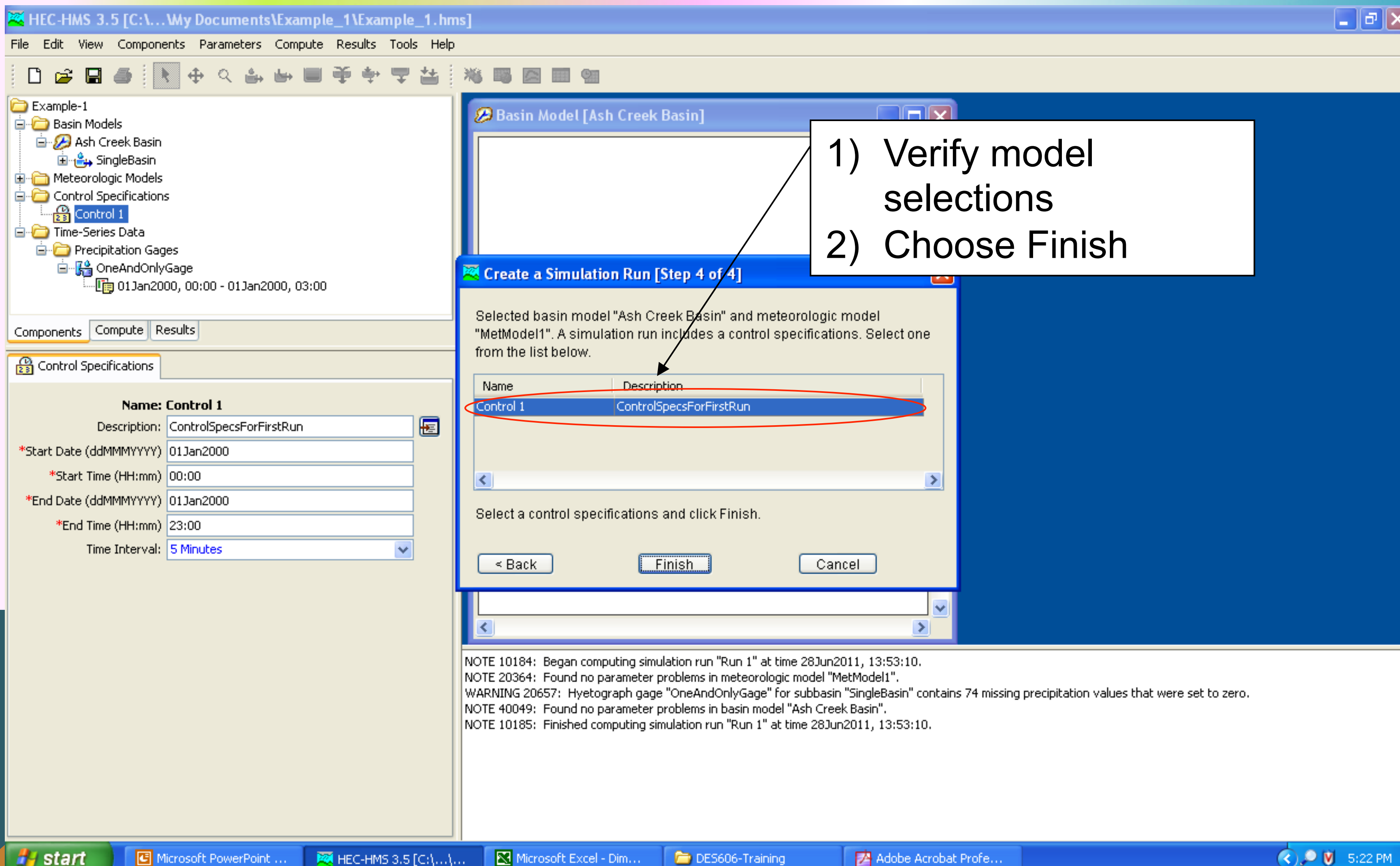
CREATE SIMULATION



CREATE SIMULATION

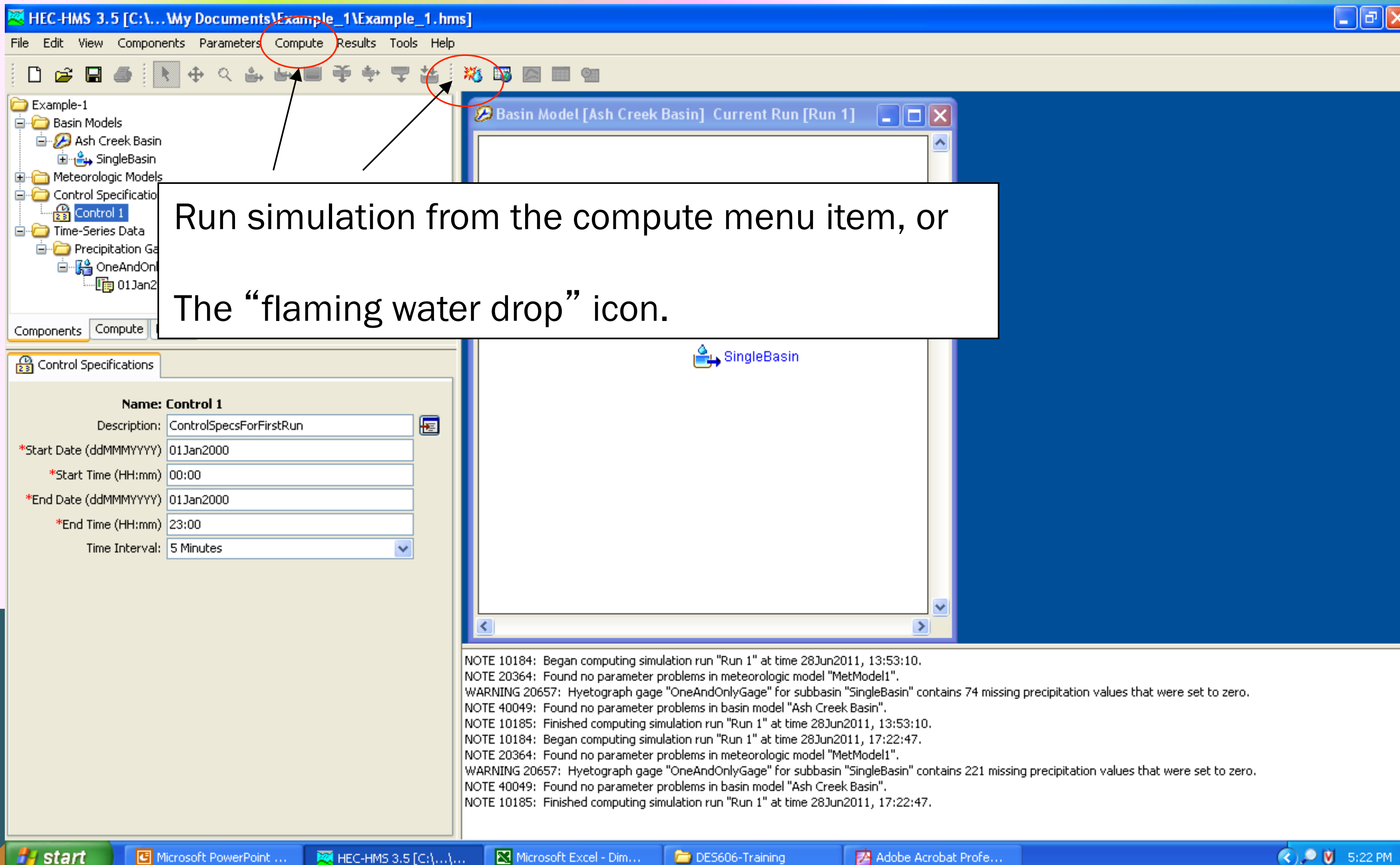


CREATE SIMULATION



1) Verify model selections
2) Choose Finish

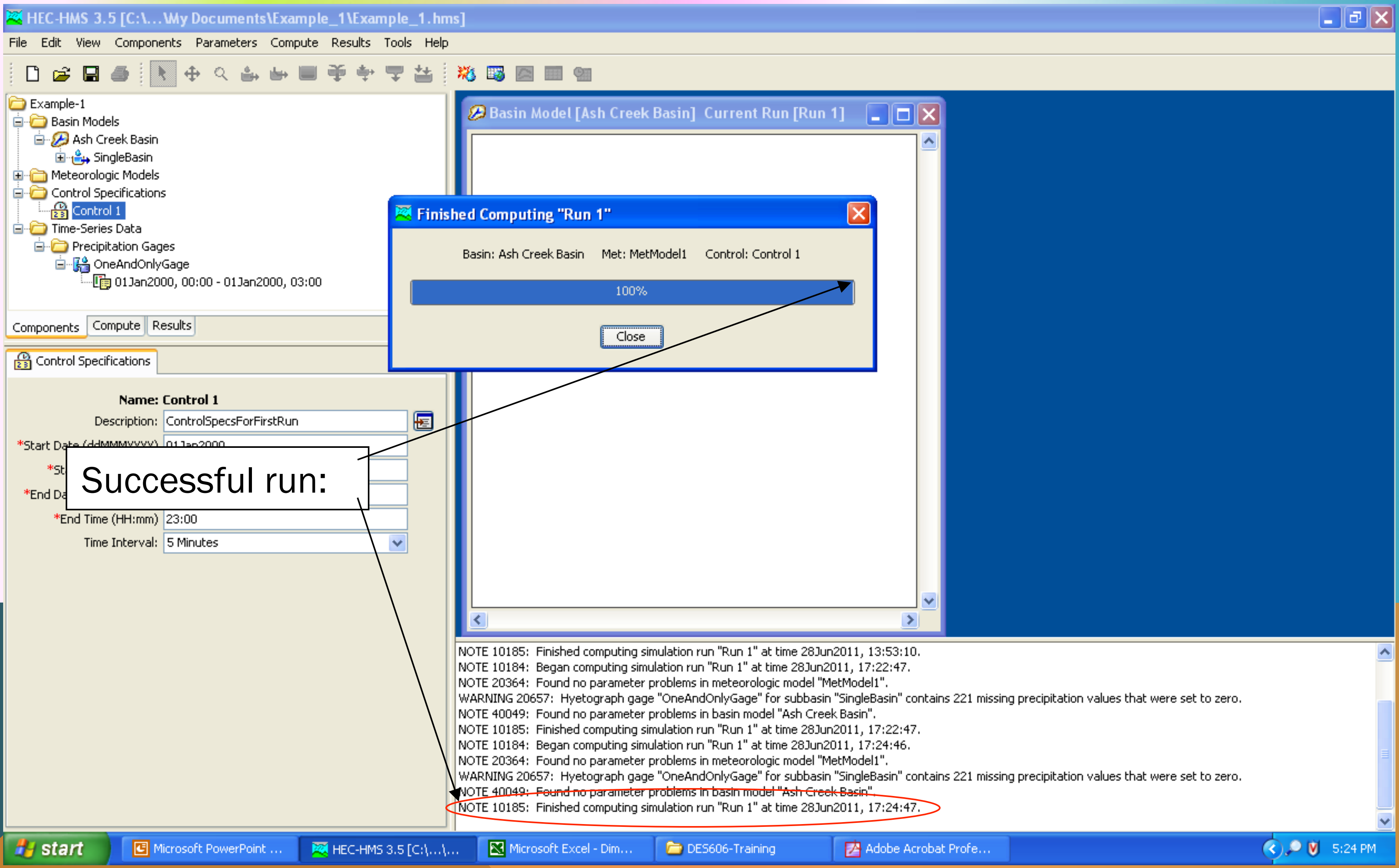
RUN SIMULATION



Run simulation from the compute menu item, or

The "flaming water drop" icon.

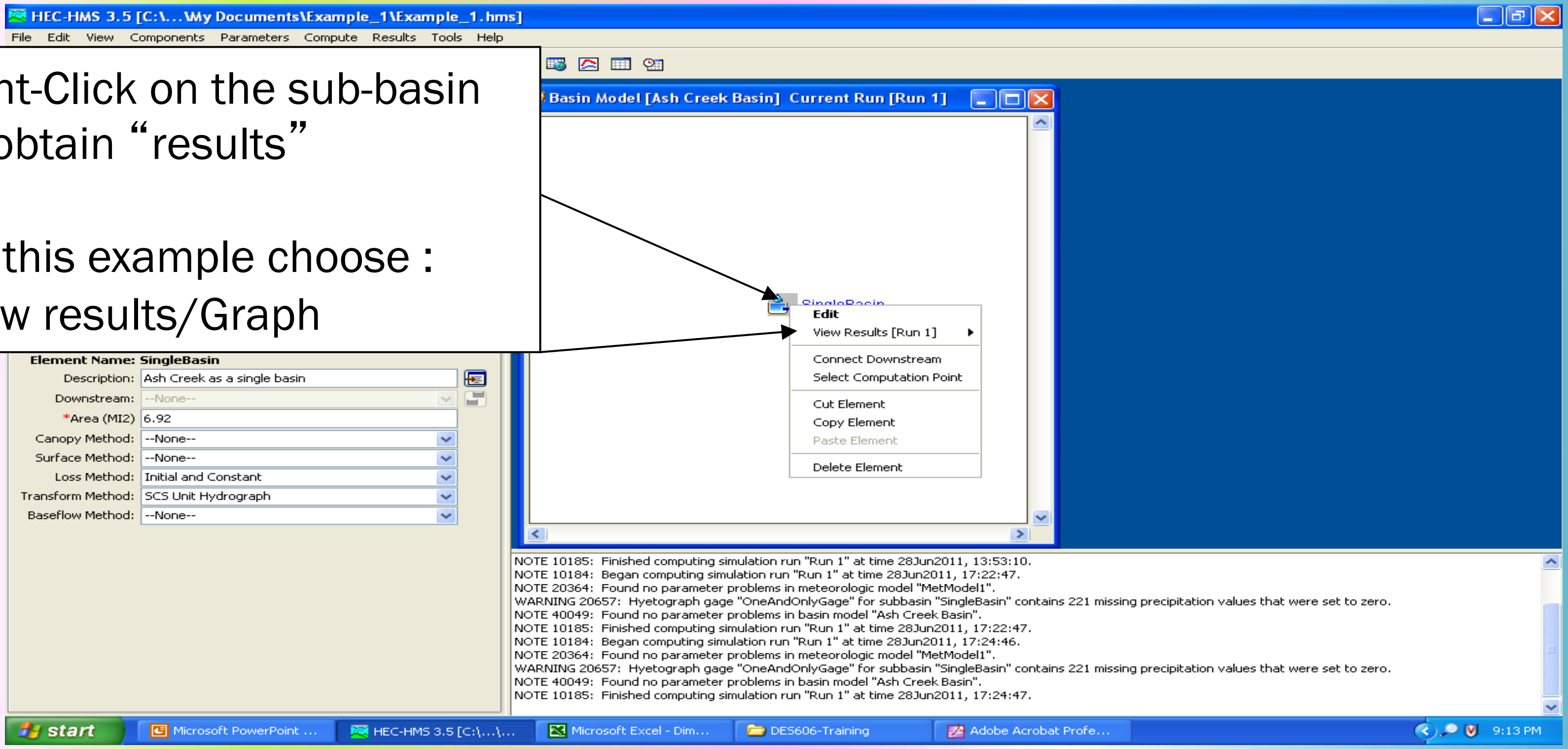
RUN SIMULATION



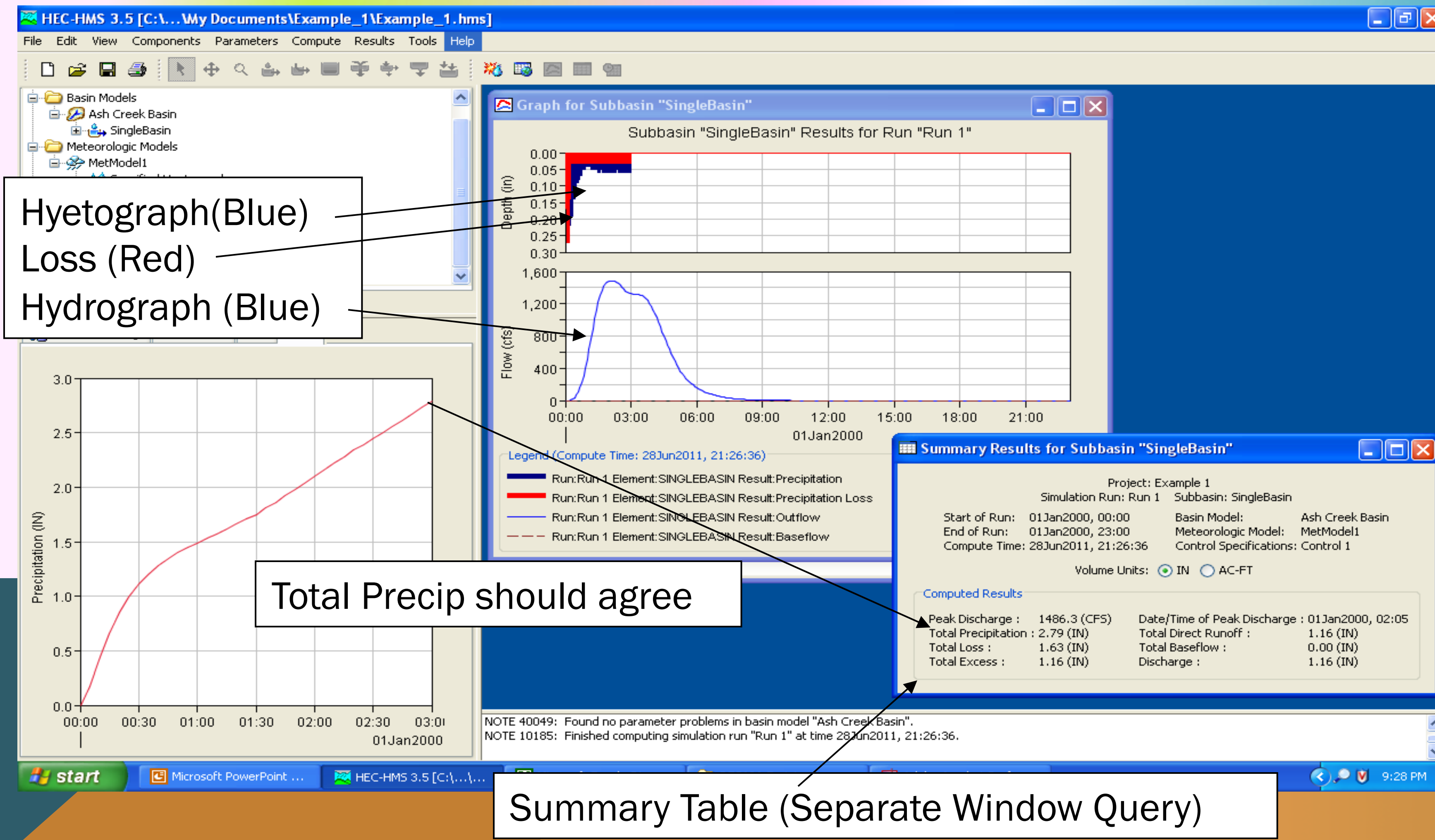
RUN SIMULATION

Right-Click on the sub-basin to obtain "results"

For this example choose : View results/Graph



VIEW RESULTS



ADD OBSERVATIONS

Intentional input basin lag as 80 minutes

Use a historical storm and see how well (or poorly) we did

Use Time-Series-Manager to add these new gages

Use Control-Specifications to build control conditions for this different run.

NEXT TIME

- ES7 Solution Sketch
- Unit Hydrographs -- HMS Workshop
  - Multiple sub-basins