

# THE IWR PLANNING SUITE II UNCERTAINTY MODULE

## PCoP WEBINAR SERIES

Shawn Komlos (CEIWR)

23 JUL 2020



US Army Corps  
of Engineers®



**How familiar are you with the IWR Planning Suite?  
Please place a check/mark in one of the boxes below.**

**Novice**

**Experienced**

**Expert**

**Click on the Annotation option  on the left side of your screen and then use the Pencil Tool or checkmark to mark your response.**

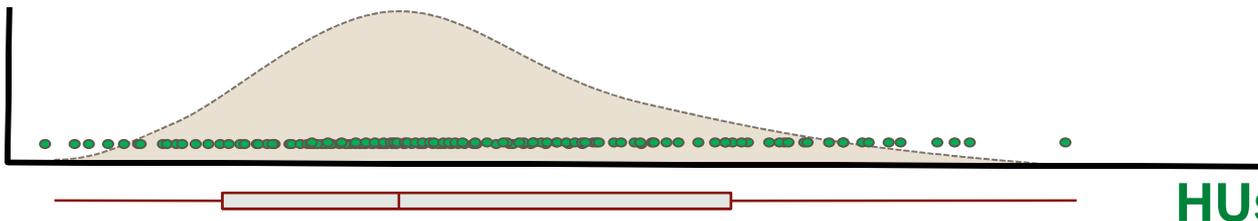


**US Army Corps  
of Engineers.**



# Webinar topics

- The IWR Planning Suite II Basics
  - What is new about the IWR Planning Suite II
  - Quick Walkthrough of It's Basic Mechanics
- The Uncertainty Module
  - Components, Features, and Options
  - Quick Walkthrough of It's Basic Mechanics
  - Charts, Tables, and Reports
  - Interpretation of Uncertainty-Informed Cost Effectiveness and Incremental Cost Analyses (CEICA)
- Where can I get the software?
- Training resources & help



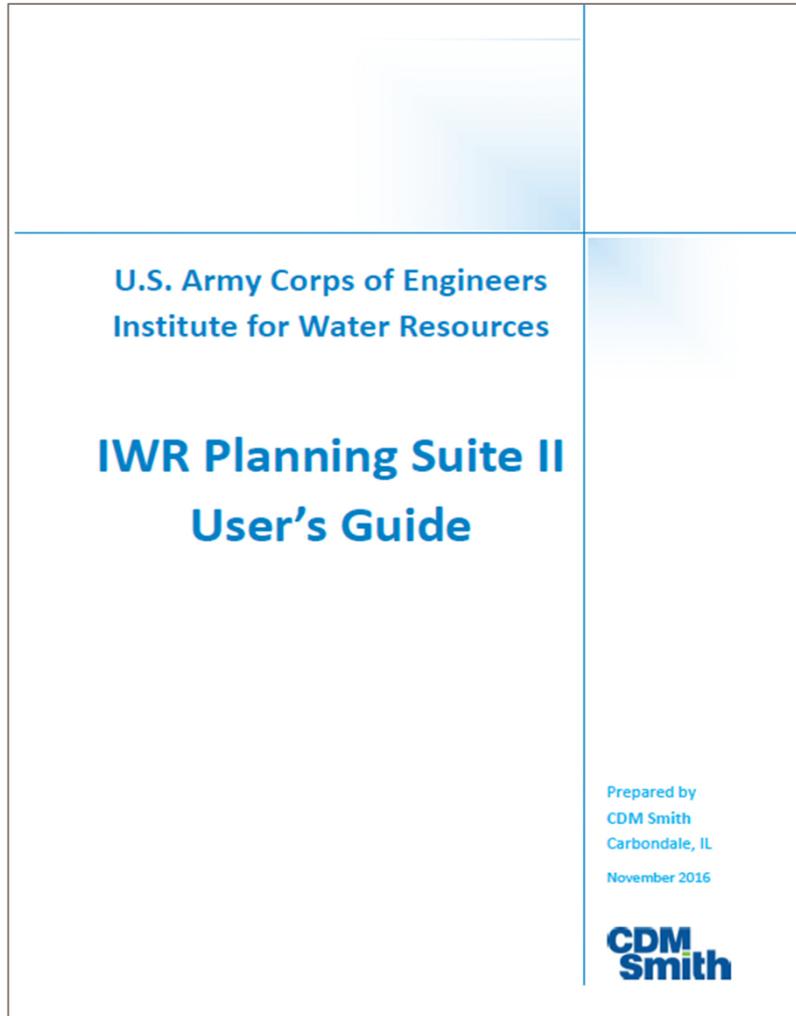
HUs



US Army Corps  
of Engineers.



# IWR Planning Suite II: The Basics



- Provide for consideration of monetized and non-monetized costs and benefits
- Automate computations associated with CEICA
- Facilitate documentation, visualization, reporting, and communication of CEICA
- Enable consideration of multiple variables, and support assessment of uncertainty on CEICA results
- Support risk-informed decision making



US Army Corps  
of Engineers.



# USACE-Certified Versions

## IWR Planning Suite Version 1.0.11.1

- Plan Generator and CE/ICA
- Derived Value Calculator/Module

## IWR Planning Suite Version 2.0.6.1

- Plan Generator and CE/ICA
- Derived Value Calculator/Module
- Added the Annualizer Module

## Version 2.0.9 aka IWR Planning Suite II

- Updated Interface
- Plan Generator and CE/ICA
- Derived Value Calculator/Module
- Annualizer Module
- Added MCDA Module
- Added Uncertainty Module
- Added Watershed Module
- Added Report Generator



US Army Corps  
of Engineers.

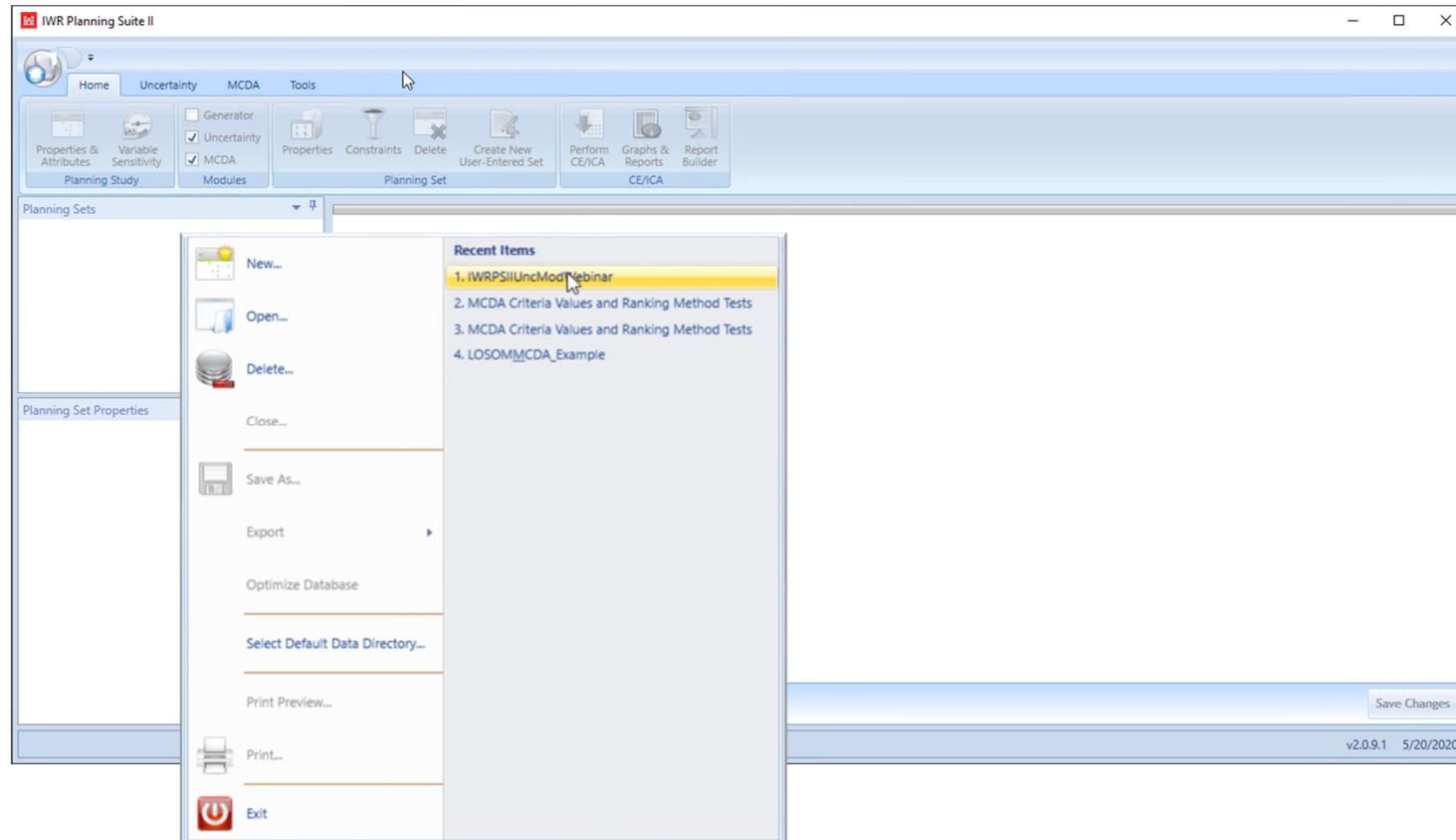


# IWR Planning Suite II: Status

- **CERTIFIED**
- **31-MAY-2018 CECW-P Memorandum**
  - All review plans approved after 31-MAY-2018 must show use of the latest version of the IWRPS II.
  - Migration to IWRPS II also required for ongoing studies that had not scheduled a TSP meeting as of 31-MAY-2018.
  - Exemptions might be granted for ongoing studies (case by case).
  - Studies engaging in multiple criteria decision analysis should engage the ECO-PCX to develop a strategy for appropriate and policy compliant use.
- **ER 1105-2-100 (Planning Guidance Notebook)**
  - Provides instruction for NED and NER methods
  - Provides instruction on use of CE/ICA during selection of NER plan and for all recommended mitigation plans
- **IWR Planning Suite Users' Guide**  
<https://publibrary.planusace.us/document/5641c105-449e-4b7f-c52f-af91a15a99e2>



# IWRPS II - Getting Started (The Basics)



***Prepare your working directory...  
Set up your project file...***

# IWRPS II – Properties and Attributes

**Properties & Attributes**

**Planning Study [IWRPSIIUncModWebinar] Properties**

**Name**  
IWRPSIIUncModWebinar

**Description**  
This is a hypothetical planning set that has been developed to illustrate uses and mechanics of the IWR Planning Suite II Uncertainty Module.

**Variables**

Name	Units	Description	Variable Type	Derived	Derived Function
Cost	\$1000	Average Annual Cost in \$1000s	Currency	<input type="checkbox"/>	
Output	Habitat Units	Output in Average Annual Habitat Units	Decimal	<input type="checkbox"/>	
WaterAvailabilityRisk	AvailabilityDa	Average Annual Change in Number of Days [(	Decimal	<input type="checkbox"/>	
Recreation	AccessDays	Average Annual Change in Number of Days [(	Decimal	<input checked="" type="checkbox"/>	[RecreationEarlySeason]+
RecreationEarlySeason	AccessDays	Average Annual Change in Number of Days [(	Decimal	<input type="checkbox"/>	
RecreationLateSeason	AccessDays	Average Annual Change in Number of Days [(	Decimal	<input type="checkbox"/>	

*Describe your costs...*  
*Describe your outputs...*  
*Describe any other captured effects...*

# IWRPS II – Defining the Variables

Planning Study [IWRPSIIUncModWebinar] Properties

Name  
IWRPSIIUncModWebinar

Description  
This is a hypothetical planning set that has been developed to illustrate uses and mechanics of the IWR Planning Suite II Uncertainty Module.

Variables

Name	Units	Description
Cost	\$1000	Average
Output	Habitat Units	Output
WaterAvailabilityRisk	AvailabilityDe	Average
Recreation	AccessDays	Average
RecreationEarlySeason	AccessDays	Average
RecreationLateSeason	AccessDays	Average

Formula Editor - Derived Variable 'Recreation'

[RecreationEarlySeason]+ [RecreationLateSeason]

Validated

Select Variables

- Cost
- Output
- WaterAvailabilityRisk
- RecreationEarlySeason
- RecreationLateSeason

OK Cancel

***Define any derived variables...***



US Army Corps  
of Engineers.



# IWRPS II – Building the plans

Plan	Plan Description	Cost	Output	WaterAvailabilityRisk	Recreation	RecreationEarlySeason	RecreationLateSeason
No Action Plan	Default No Action Plan	\$0.00	0	0	0	0	0
Red Plan		\$0.00	0	0	0	0	0
Orange Plan		\$0.00	0	0	0	0	0
Yellow Plan		\$0.00	0	0	0	0	0
Green Plan		\$0.00	0	0	0	0	0
Blue Plan		\$0.00	0	0	0	0	0

*You can use the plan generator  
or  
directly input the name, descriptions and  
values for variables associated with each plan.*

# IWRPS II – Estimating your inputs

**Annualization Calculator**

Annualization Set: **Outputs**

**Initial Terms**

Base Year: 2020  
 Period of Analysis (years): 50  
 Capital Recovery Factor: 0.034001

**Initial Cost Details**

Total Initial Cost - \$1,404,160,000.00  
 Construction: \$1,400,000,000.00  
 Total Investment Cost - \$1,404,160,000.00  
 Total Initial Cost: \$1,404,160,000.00

**NER Output Details**

Variable: Output  
 Calculate By:  Linear Interpolation  Growth Rate  
 Max Output (units): 5,200  
 Average Annual Output: 2,402.5

Control	Year	Output
<input type="checkbox"/>	2031	466.67
<input type="checkbox"/>	2032	700
<input type="checkbox"/>	2033	933.33
<input type="checkbox"/>	2034	1,166.67
<input checked="" type="checkbox"/>	2035	1,400
<input type="checkbox"/>	2036	1,440
<input type="checkbox"/>	2037	1,480
<input type="checkbox"/>	2038	1,520

**Annual Output**  
 (Time is in years and output is in units)

Units vs. Time in Years graph showing an S-curve from 0 to 5,000 units over time.

*Annualize your costs and outputs...*



# IWRPS II – Entering your inputs

The screenshot displays the IWR Planning Suite II interface. The main window shows a table of planning alternatives. The 'Blue Plan' row is highlighted in yellow. A 'Formula Editor' dialog box is open, showing the formula '[RecreationEarlySeason] + [RecreationLateSeason]' and a 'Select Variables' list with 'RecreationEarlySeason' and 'RecreationLateSeason' selected. A blue arrow points from the 'RecreationEarlySeason' column in the table to the formula editor, and a red arrow points from the formula editor to the 'RecreationLateSeason' column in the table. A blue star is placed below the 'Blue Plan' row.

Plan	Plan Description	Cost	Output	WaterAvailability	RecreationEarlySeason	RecreationLateSeason
No Action Plan	Default No Action Plan	\$0.00	0	0	0	0
Red Plan	Extensive Construction, Active Management	\$48,000.00	2,400	15	0	15
Orange Plan	Extensive Construction, Passive Management	\$45,000.00	2,000	10	0	10
Yellow Plan	Nature-Based, Active Management	\$36,000.00	2,400	20	5	15
Green Plan	Nature-Based, Passive Management	\$30,000.00	2,300	19	7	12
Blue Plan	Incremental Adaptive Construction	\$22,000.00	1,900	14	7	7

***Enter the values for each variable, for each of the planning alternatives.***

★ ***Values of derived variables will be calculated automatically...  
(A feature that will be of increased importance in the coming slides)***

# IWRPS II – Generating your analyses

The screenshot displays the IWR Planning Suite II interface. The 'User-Entered Sets' list includes 'Cost v Output (CEICA)', 'Cost v Water Availability Risk (CEICA)', and 'Cost v Recreation (CEICA)'. A red box highlights these items, with a red arrow pointing to the 'Perform CE/ICA' button in the 'Tools' ribbon, which is also circled in red and labeled with a '1'. A second red circle labeled '2' is positioned above the 'Perform CE/ICA' button. A large blue arrow points from the 'Perform CE/ICA' button to the 'CEICA Results Viewer' window. This window shows a 'Cost v Output' graph with a legend indicating 'Non Cost Effective' (blue circle), 'Cost Effective' (red triangle), and 'Best Buy' (green square). The 'Planning Set Graph' window shows a scatter plot of 'Cost (\$10,000)' vs 'Output (Habitat Units)' with the same legend. The 'CEICA Results Viewer' window also shows a table of plan alternatives with columns for Plan, Plan Description, and Cost.

Plan	Plan Description	Cost
No Action Plan	Default No Action Plan	
Red Plan	Extensive Construction, Active Management	\$48,000
Orange Plan	Extensive Construction, Passive Management	\$45,000
Yellow Plan	Nature-Based, Active Management	\$36,000
Green Plan	Nature-Based, Passive Management	\$30,000
Incremental Adaptive Construction	Incremental Adaptive Construction	\$22,000

**Perform the CEICA on your data to analyze costs against any of the outputs.**

**View Graphs and Reports.**



US Army Corps  
of Engineers.



# IWRPS II – Generating your report

The screenshot shows the IWR Planning Suite II software interface. The 'Report Builder' icon in the ribbon is highlighted with a red box. Several report preview windows are overlaid on the main interface, displaying various sections of a report:

- Table of Contents:** Lists sections like Metadata, References, Benefits-Cost Analysis Variable Definitions, Cost and Benefits Summary, Increased Costs and Benefits Summary, Chart of Alternatives, Chart of Cost-Effective Alternatives, and Chart of Incremental Costs and Benefits of Alternatives.
- Metadata:** Includes Best Information, Software & Version (IWR Planning Suite, Version 2.0.0), Model (IWR-Plus CE/ICA Analyzer), Date (5/2/2010), Planning Study Name (IWRPS2\Uncertainty\Water), Planning Study Description (This is a hypothetical plan...), Planning Set Name (Uncertainty Module Training Set), and Forecast Set Name (Uncertainty Module Training Set).
- References:** Lists several academic and technical references related to cost-effectiveness analysis and water resources planning.
- Best-Cost Analysis Variable Definitions:** A table with columns for Name, Unit, and Description.
 

Name	Unit	Description
Cost	\$/Year	Present Annual Cost in \$/Year
Output	Units	Output in Average Annual Units
Facilities	Acres/Day	Present Annual Change in the IWRPS2\Uncertainty\Water
Facilities/Day	Acres/Day	Present Annual Change in the IWRPS2\Uncertainty\Water
Facilities/Day	Acres/Day	Present Annual Change in the IWRPS2\Uncertainty\Water
Facilities/Day	Acres/Day	Present Annual Change in the IWRPS2\Uncertainty\Water
- Chart of Alternatives:** A bar chart showing 'Cost (10000)' on the y-axis and 'Output' on the x-axis. It compares different alternatives.
- Chart of Incremental Costs and Benefits of Alternatives:** A bar chart showing 'Incremental Cost/Benefit' on the y-axis and 'Output' on the x-axis. It compares the relative magnitudes of incremental costs and benefits for each alternative.

**Generate or prepare report to document analyses.**



US Army Corps  
of Engineers.



**Based on CEICAs that you are familiar with,  
please identify potential sources or consequences of uncertainty  
in the space below.**



**Click on the Annotation option  on the left side of your screen  
and then use the T<sub>T</sub> Tool to type your response.**

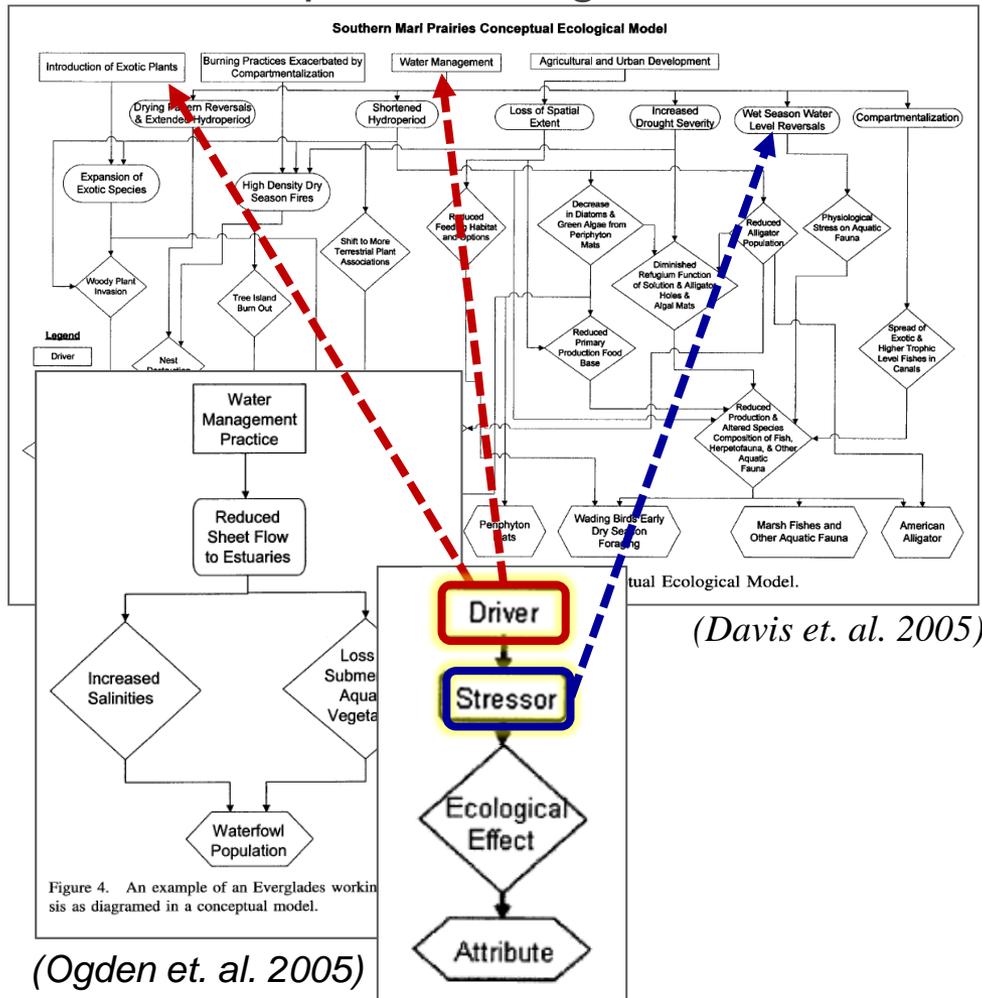


**US Army Corps  
of Engineers.**



# Potential Sources of Uncertainty

## Conceptual Ecological Model



- Costs
- Precipitation
- Disturbances
- Introduced Species
- Climate Change
- Management Decisions
- Policy
- Models
- Understanding of Systems

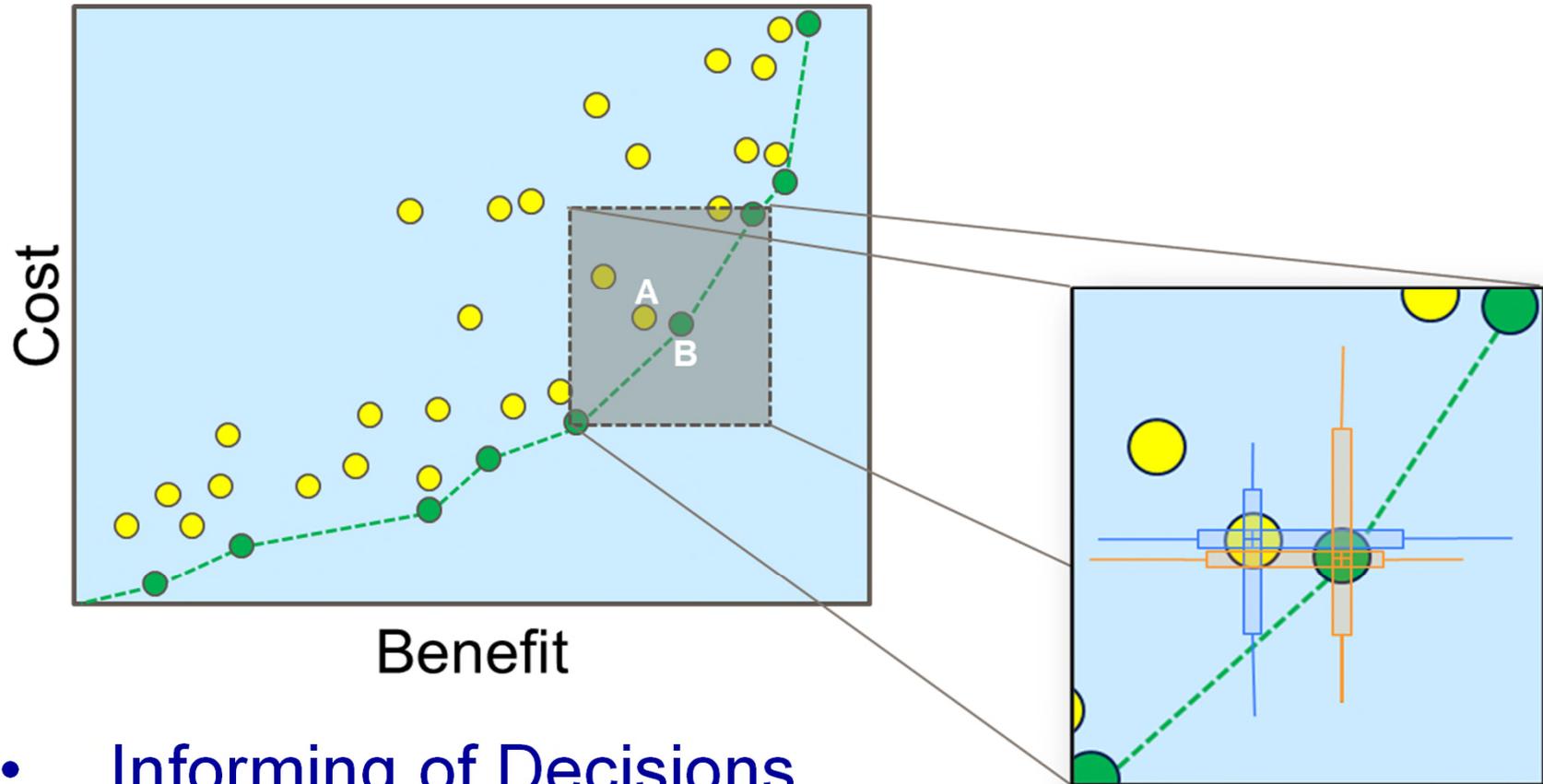
**All of the above, and more...**



US Army Corps  
of Engineers.



# The General Concept...



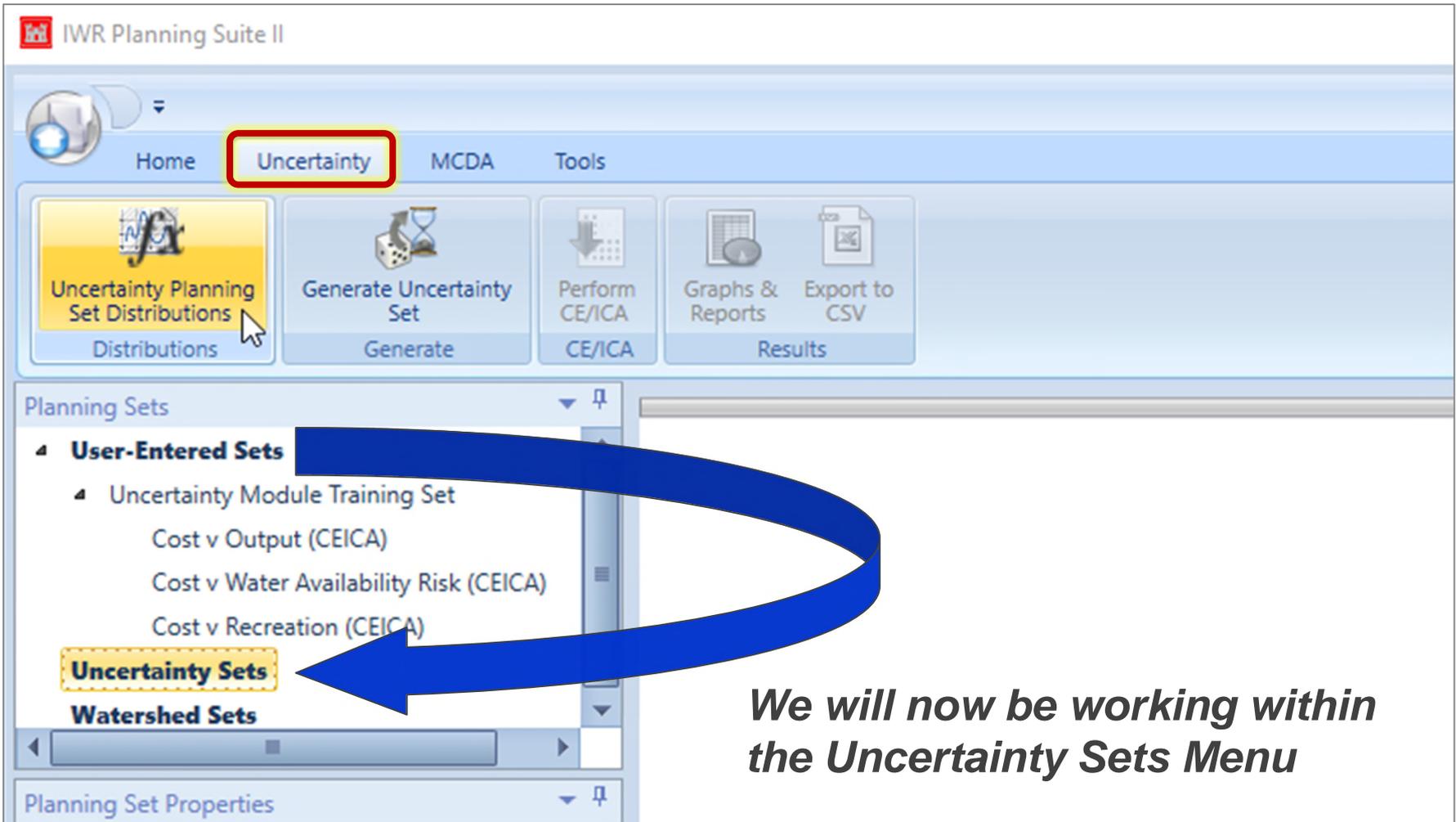
- Informing of Decisions
- Management of Trade-Offs
- Communication of Risk



US Army Corps  
of Engineers.



# Initiating an Uncertainty Set...



The screenshot displays the IWR Planning Suite II software interface. The top navigation bar includes tabs for Home, Uncertainty (highlighted with a red box), MCDA, and Tools. Below the navigation bar are several functional buttons: 'Uncertainty Planning Set Distributions' (with a mouse cursor), 'Generate Uncertainty Set', 'Perform CE/ICA', 'Graphs & Reports', and 'Export to CSV'. The 'Planning Sets' pane on the left is expanded to show a tree view under 'User-Entered Sets', which includes 'Uncertainty Module Training Set' with sub-items 'Cost v Output (CEICA)', 'Cost v Water Availability Risk (CEICA)', and 'Cost v Recreation (CEICA)'. A blue arrow points from the 'Uncertainty Sets' sub-menu item to the 'Uncertainty Sets' text in the main content area. The 'Planning Set Properties' pane is visible at the bottom.

**Uncertainty Sets**

*We will now be working within the Uncertainty Sets Menu*

# Initiating an Uncertainty Set...

The screenshot displays the 'Uncertainty Planning Set Distributions' window. The 'Distributions' tab is selected, showing six distribution types: Fixed, Normal, Uniform, Triangular, Truncated Normal, and CDF. Each type is represented by a small diagram with parameters. Below the diagrams, there is a text description: 'An unchanging constant value. A single value with no variability.' and a note: '\* Binary variables are restricted to a Fixed Distribution of either 0 or 1.' A 'Validate Distributions & Matrix' button is visible at the bottom right of the distribution selection area.

In the background, the 'IWR Planning Suite' interface is visible. The 'Generate Uncertainty Set' dialog is open, with the 'Uncertainty' button highlighted by a red circle and a red dashed arrow pointing to the 'Normal' distribution type in the main window. The 'Planning Sets' tree on the left shows 'User-Entered Sets' expanded, with 'Uncertainty Sets' highlighted by a blue arrow.

Your **Uncertainty Planning Set** will be constructed from a **Planning Set** that you have already created, or a subset of those plans.



US Army Corps  
of Engineers.



# Selecting Plans for Analysis...

Uncertainty Planning Set Distributions

Name: [ ] [New] [Delete] [Clone Distribution Set]

Distributions Variable Profile Tolerance Rules Correlation Matrix

Distribution Types

Fixed Normal

An unchanging constant value, a single value with no variability.

\* Binary variables are restricted to a Fixed Distribution of either 0 or 1.

Plan Variable Variable Type Distribution Type

Select Plan Alternatives

Name: [ ]

Load Plans from Existing Set  Use Custom Plans

Select All/None

Plan	Plan Description	Selected
No Action Plan	Default No Action Plan	<input checked="" type="checkbox"/>
Red Plan	Structural Approach, Active Management	<input checked="" type="checkbox"/>
Orange Plan	Structural Approach, Passive Management	<input checked="" type="checkbox"/>
Yellow Plan	NNBF Approach, Active Initial Management	<input checked="" type="checkbox"/>
Green Plan	NNBF Approach, Passive Management	<input checked="" type="checkbox"/>

[Add New] [Create] [Cancel]

Select Plan Alternatives

Name: [ ]

Load Plans from Existing Set  Use Custom Plans

User-Entered Plans

- Uncertainty Planning Set
- Module Training Set
- Cost v Output (CEICA)
- Cost v Water Availability Risk
- Cost v Recreation (CEICA)

Uncertainty Sets

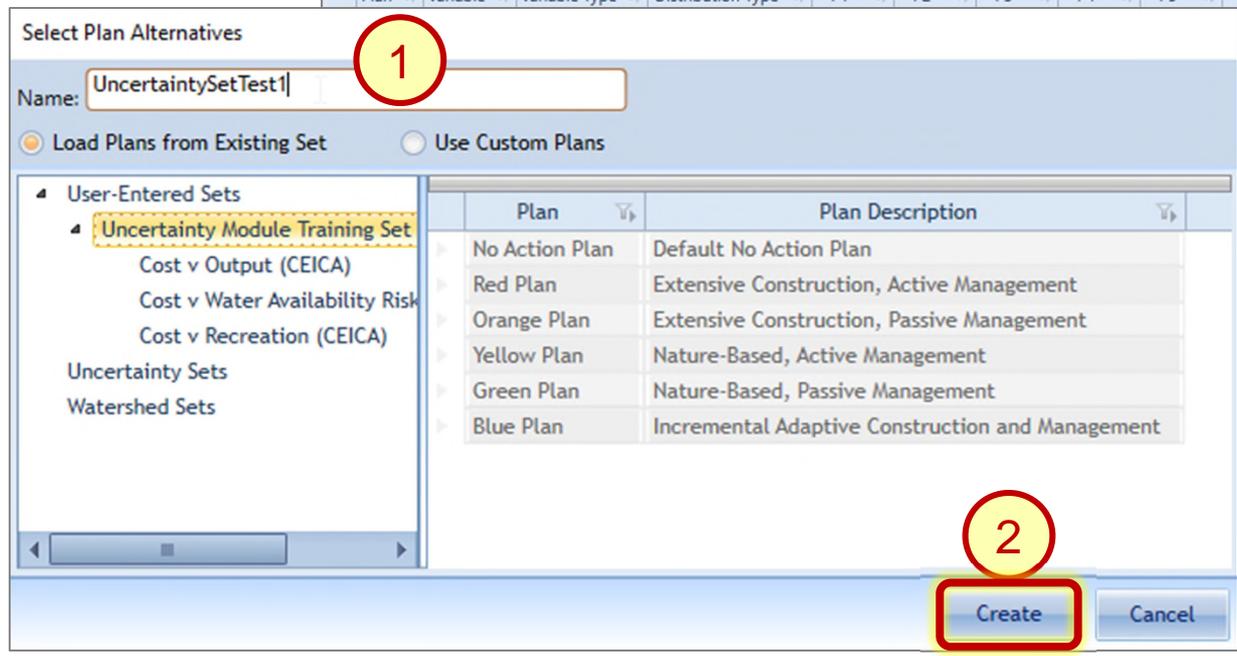
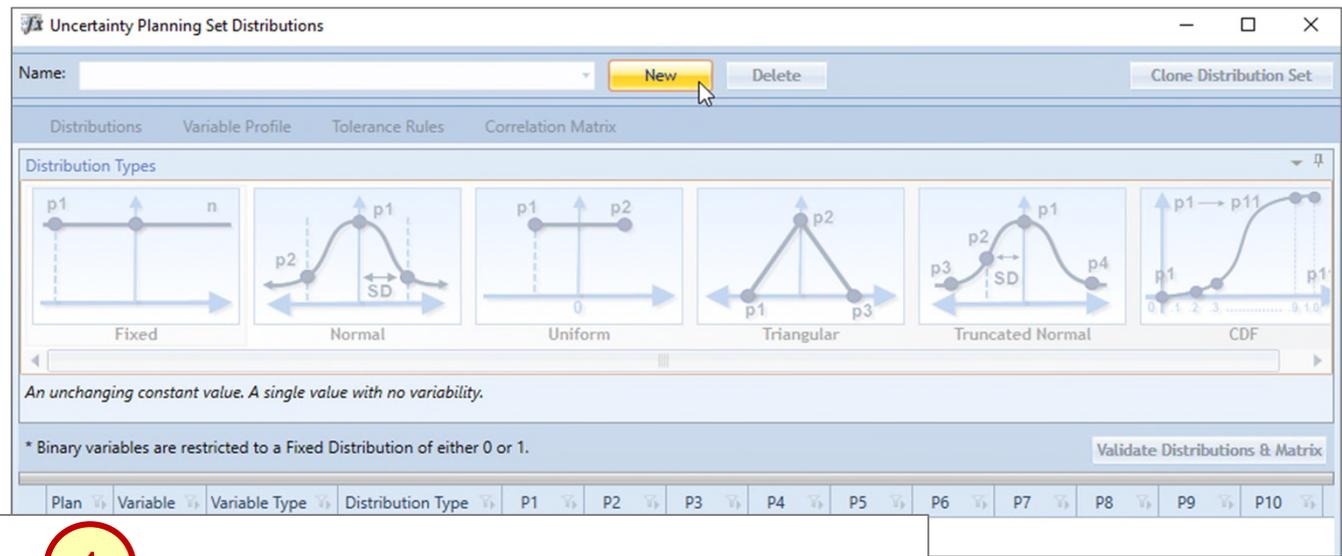
Watershed Sets

Plan	Plan Description
No Action Plan	Default No Action Plan
Red Plan	Extensive Construction, Active Management
Orange Plan	Extensive Construction, Passive Management
Yellow Plan	Nature-Based, Active Management
Green Plan	Nature-Based, Passive Management
Blue Plan	Incremental Adaptive Construction and Management

[Create] [Cancel]

... to select a subset.

# Naming the Uncertainty Set...



# The *Uncertainty Set* Window

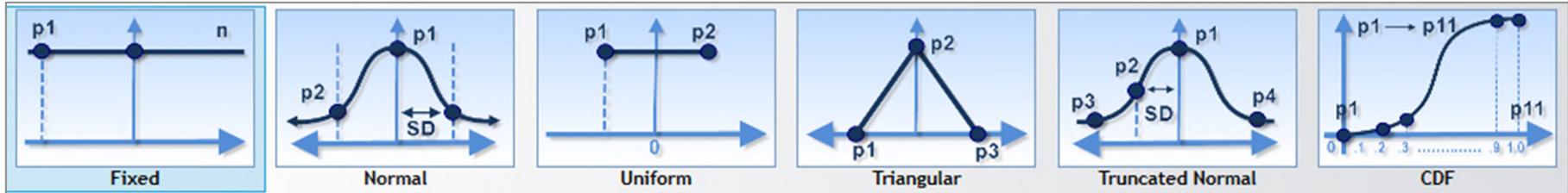
Distribution Tab    Variable Profile Tab    Tolerance Rules Tab    Correlation Matrix Tab

Distribution Options

Plans    Variables    Distribution    Distribution Parameters



# Distribution Options



## *Supported distributions:*

- **Fixed** – Unchanging constant value
- **Normal** – Statistical bell-curve based on mean and standard deviation
- **Uniform** – All values within the range are equally likely
- **Triangular** – Based on min, most-likely, and max values
- **Truncated Normal** – Normal with option for setting min and max values
- **User-Defined Cumulative Distribution Function** – Custom

**Built-in Monte Carlo engine will generate values for each variable in accordance with the distributions and parameters selected by the user.**



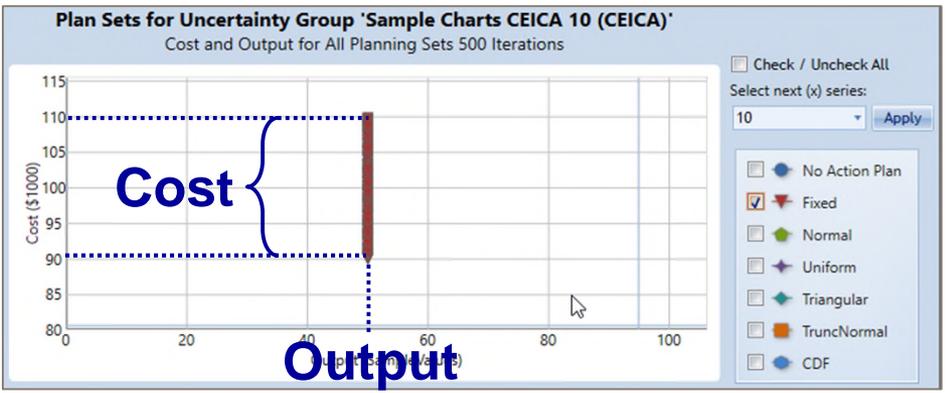
US Army Corps  
of Engineers.



# Distribution Options

*Cost reflected as uniform (90-110)*

**Output reflected as...  
Fixed**

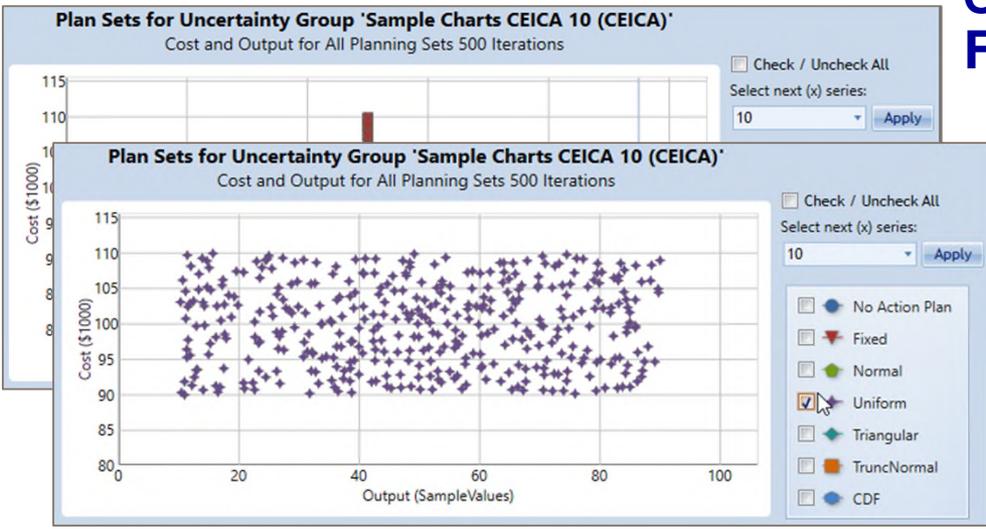


# Distribution Options

*Cost reflected as uniform (90-110)*

**Output reflected as...  
Fixed**

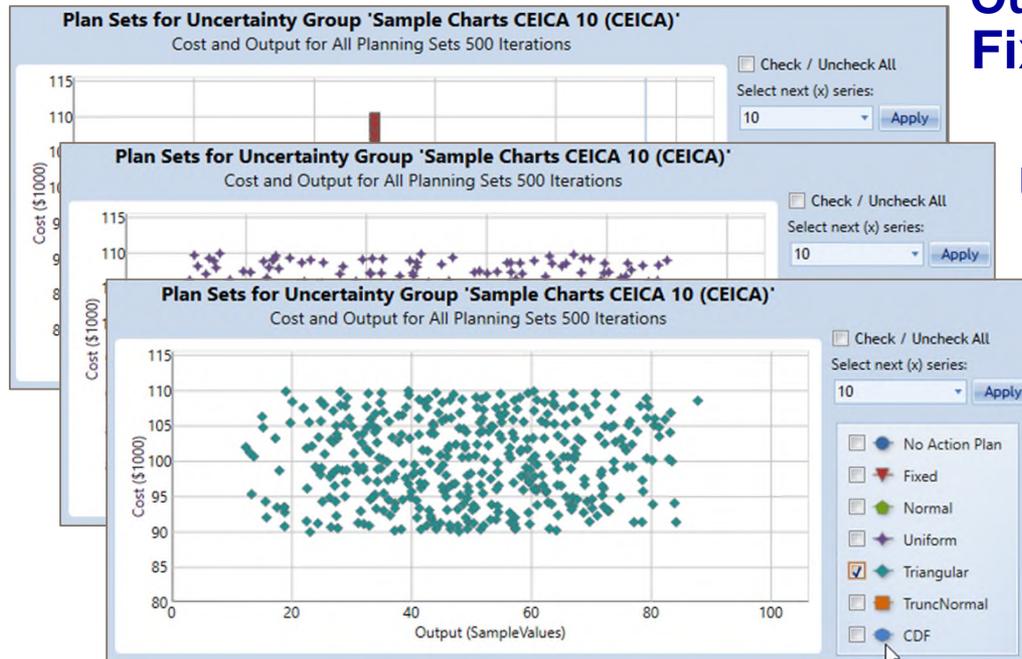
**Uniform**



# Distribution Options

*Cost reflected as uniform (90-110)*

*Output reflected as...  
Fixed*



**Uniform**

**Triangular**



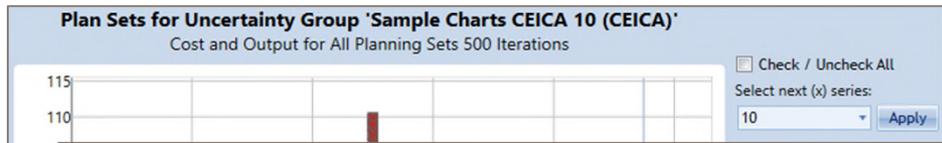
US Army Corps  
of Engineers.



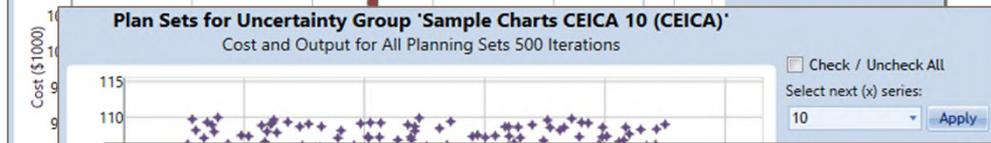
# Distribution Options

*Cost reflected as uniform (90-110)*

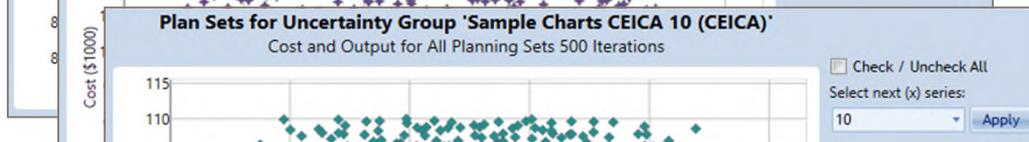
**Output reflected as...  
Fixed**



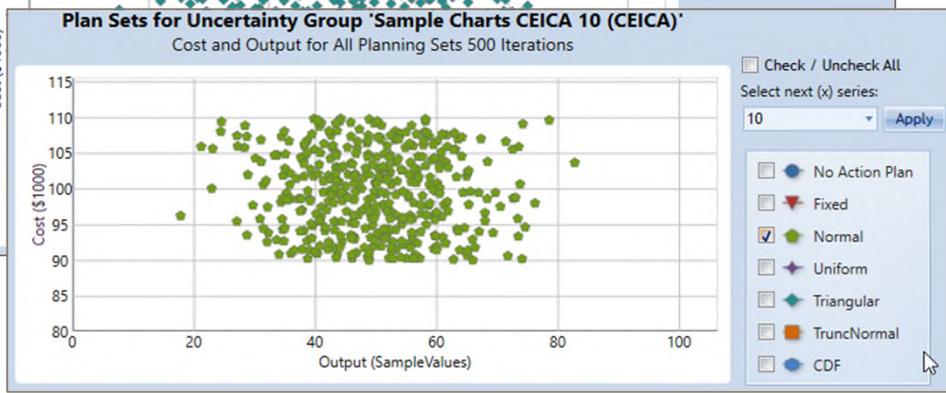
**Uniform**



**Triangular**



**Normal**



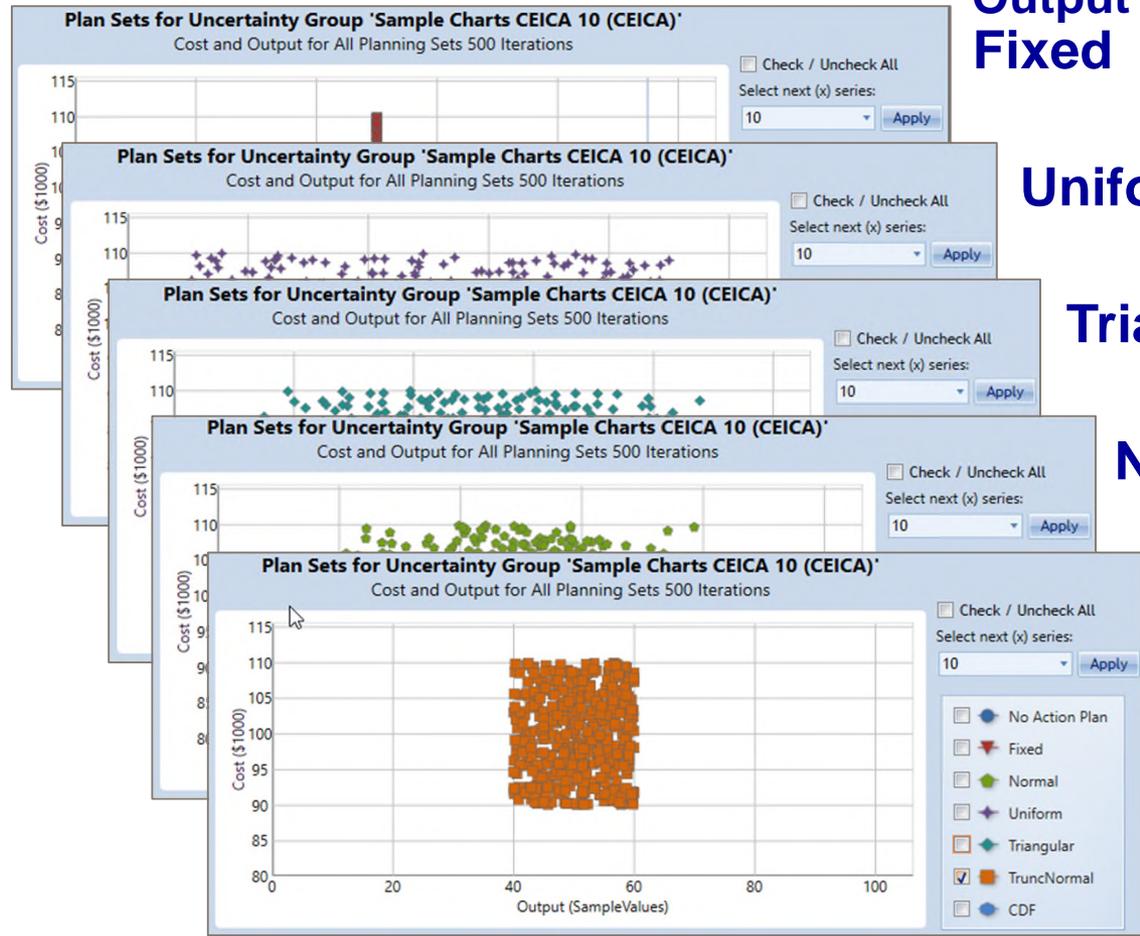
US Army Corps  
of Engineers.



# Distribution Options

*Cost reflected as uniform (90-110)*

**Output reflected as...  
Fixed**



**Uniform**

**Triangular**

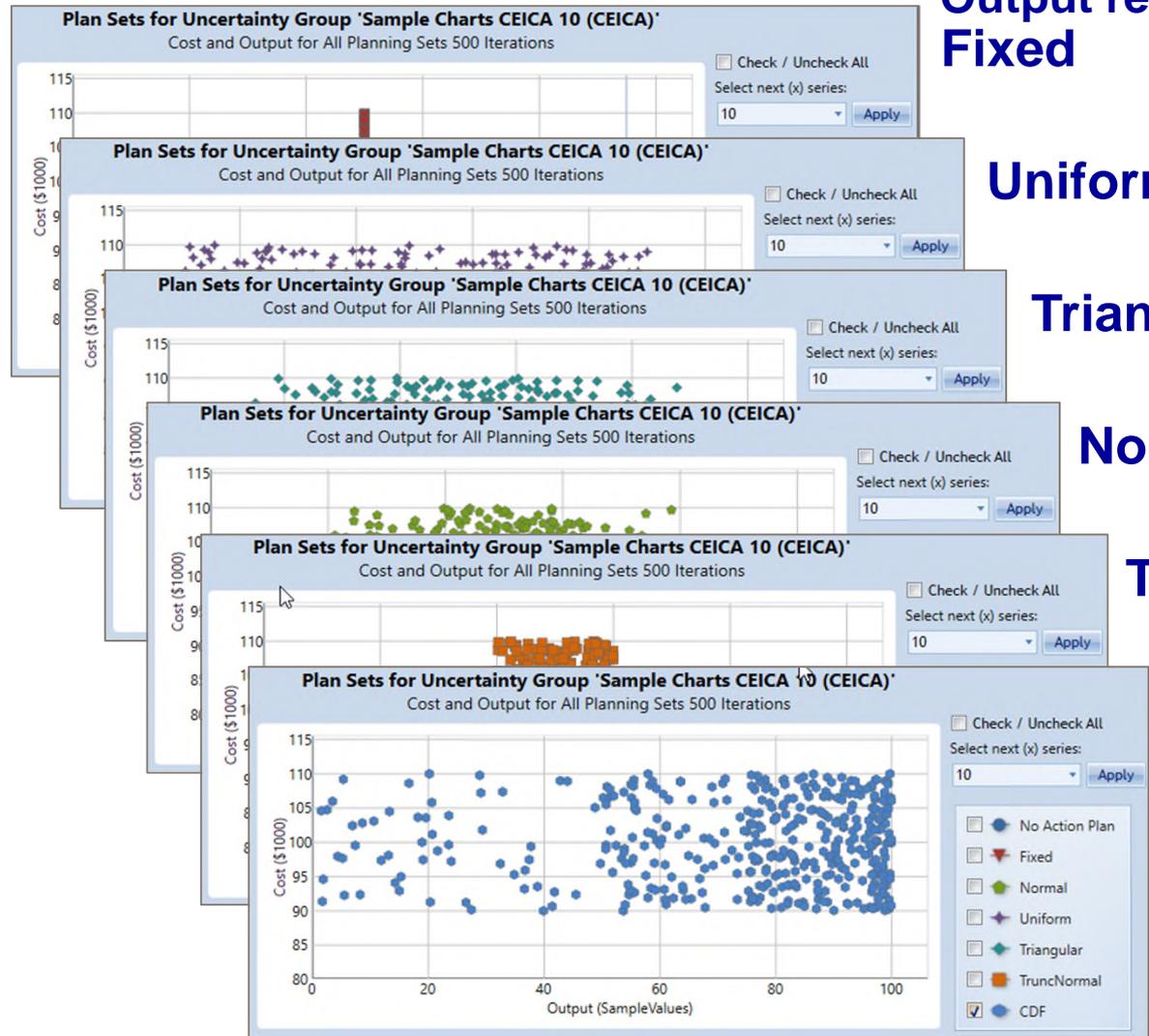
**Normal**

**Truncated Normal**

# Distribution Options

Cost reflected as uniform (90-110)

Output reflected as...  
**Fixed**



**Uniform**

**Triangular**

**Normal**

**Truncated Normal**

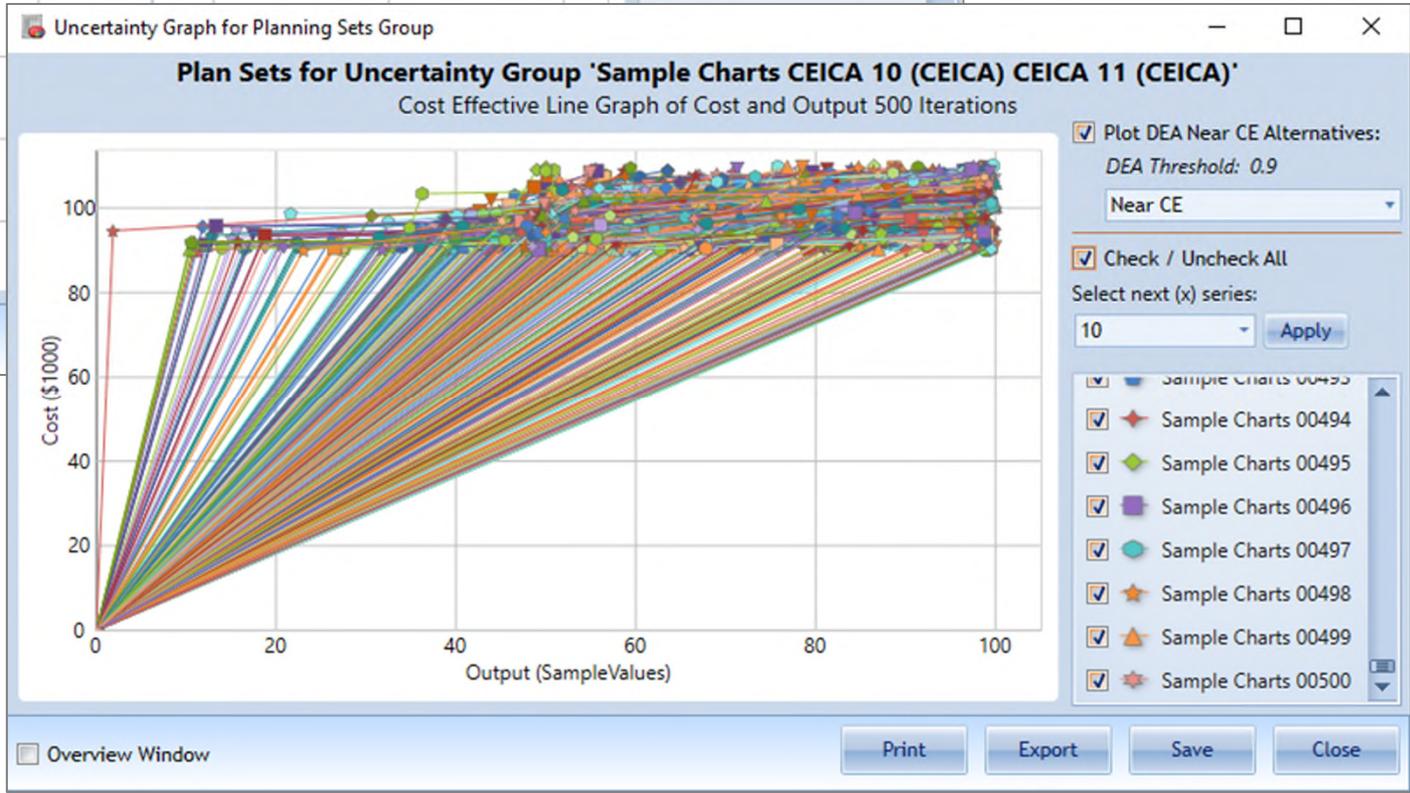
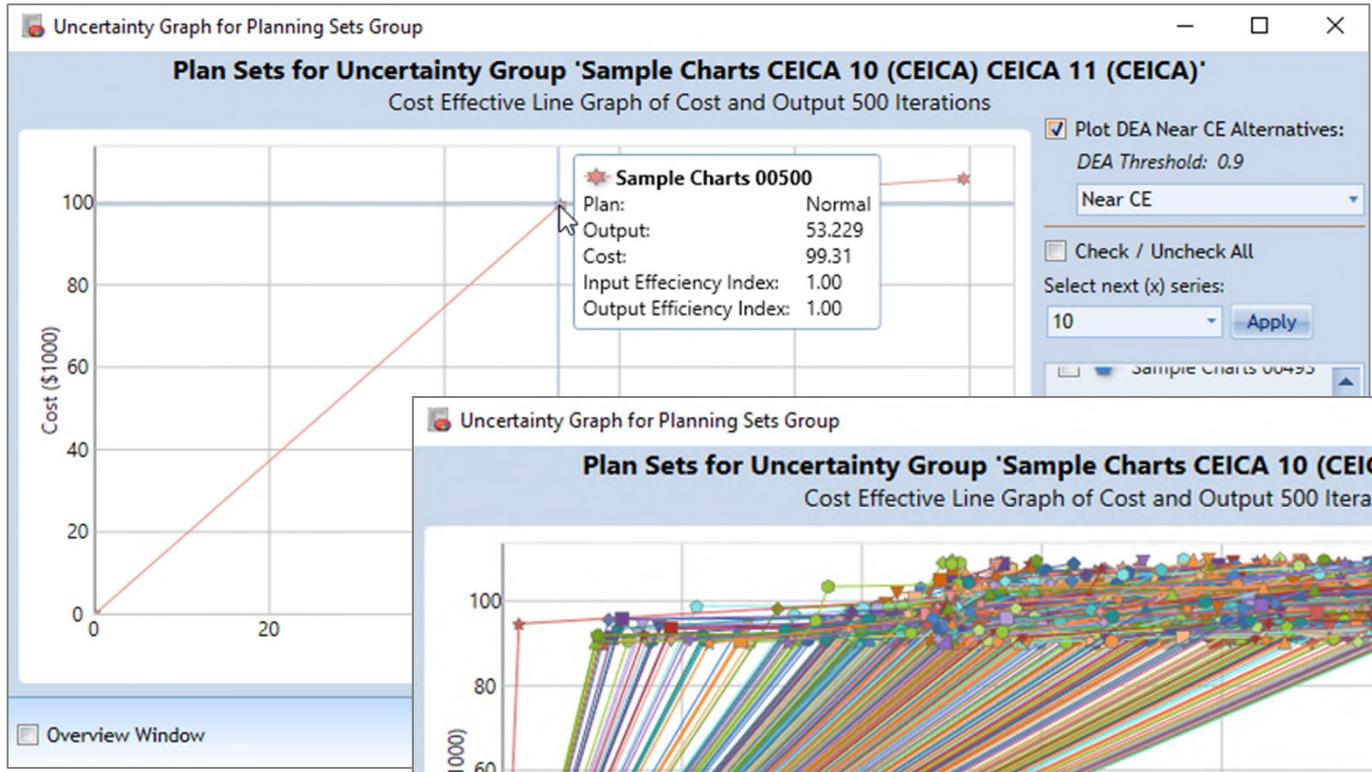
**Custom (CDF)**



**US Army Corps of Engineers.**



# Distribution Options



# Assigning Distributions: Variable Profiles Tab

1

2

3

Apply Profile

Selected	Variable	Variable Type	Distribution Type	P1	P2	P3	P4	P5	P6
<input checked="" type="checkbox"/>	Cost	Currency	Fixed	\$0.00					
<input checked="" type="checkbox"/>	Output	Decimal	Triangular	0	0	0			
<input checked="" type="checkbox"/>	WaterAvailabilityRisk	Decimal	Fixed	0					
<input checked="" type="checkbox"/>	Recreation	Decimal	Normal	0					
<input checked="" type="checkbox"/>	RecreationEarlySeason	Decimal	Uniform	0	0	0			
<input checked="" type="checkbox"/>	RecreationLateSeason	Decimal	Triangular	0	0	0			

Uncertainty Planning Set Distributions

Name: UncertaintySetTest1

Distributions Variable Profile Tolerance Rules Correlation Matrix

Distribution Types

An unchanging constant value. A single value with no variability.

\* Binary variables are restricted to a Fixed Distribution of either 0 or 1.

Plan	Variable	Variable Type	Distribution Type	P1	P2	P3	P4	P5	P6	P7	P8	P9
No Action Plan	RecreationLateSeason	Decimal	Fixed	0.00								
Red Plan	Cost	Currency	Fixed	0.00								
Red Plan	Output	Decimal	Triangular	0.00	0.00	0.00						
Red Plan	WaterAvailabilityRisk	Decimal	Fixed	0.00								
Red Plan	Recreation	Decimal	Fixed	0.00								
Red Plan	RecreationEarlySeason	Decimal	Triangular	0.00	0.00	0.00						
Red Plan	RecreationLateSeason	Decimal	Triangular	0.00	0.00	0.00						
Orange Plan	Cost	Currency	Fixed	0.00								
Orange Plan	Output	Decimal	Triangular	0.00	0.00	0.00						
Orange Plan	WaterAvailabilityRisk	Decimal	Fixed	0.00								
Orange Plan	Recreation	Decimal	Fixed	0.00								

Allows users to assign a distribution to a variable for use among all plans, as opposed to assigning plan-specific distributions.



# Inputting Parameter Values

Complete for all plans...

Plan	Plan Description	Cost	Output	WaterAvailabilityRisk	Recreation	RecreationEarlySeason	RecreationLateSeason
No Action Plan	Default No Action Plan	\$0.00	0	0	0	0	0
Red Plan	Extensive Construction, Active Mana	\$48,000.00	2,400	50	15	0	15
Orange Plan	Extensive Construction, Passive Man	\$45,000.00	2,000	45	10	0	10
Yellow Plan	Nature-Based, Active Management	\$36,000.00	2,400	30	20	5	15
Green Plan	Nature-Based, Pass						

Uncertainty Planning Set Distributions

Name: UncertaintySetTest1

Distributions | Variable Profile | Tolerance Rules | Correlation Matrix

Distribution Types

The Cumulative Distribution Function (CDF) parameters P1 through P11 describe the probability of a returned value less than the parameter. P1 corresponds to zero and P11 to 1. Other parameters have equally spaced correspondences between 0 and 1, namely, 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.

\* Binary variables are restricted to a Fixed Distribution of either 0 or 1.

Plan	Variable	Variable Type	Distribution Type	P1	P2	P3	P4	P5	P6	P7	P8	P9
No Action Plan	RecreationLateSeason	Decimal	Fixed	0.0								
Red Plan	Cost	Currency	Fixed	0.00								
Red Plan	Output	Decimal	Triangular	1,600.00	2,400.00	2,800.00						
Red Plan	WaterAvailabilityRisk	Decimal	Fixed	0.00								
Red Plan	Recreation	Decimal	Fixed	0.00								
Red Plan	RecreationEarlySeason	Decimal	Triangular	0.00	0.00	0.00						
Red Plan	RecreationLateSeason	Decimal	Triangular	0.00	0.00	0.00						
Orange Plan	Cost	Currency	Fixed	0.00								

The previously-used single value is now represented as a triangular distribution...



# Generate Uncertainty Set

**1** Generate Uncertainty Set

**2** Select Distribution Set: UncertaintySetTest1

**3** Planning Set Name: UncertaintySetTest1

**3** Description: Demonstration of the IWRPS-II Uncertainty Module; 100 Iterations, no convergence criteria

**4** OK

Variable	Convergence	Threshold (%)	Threshold (Value)
Cost	<input type="checkbox"/>	0.00	0.00
Output	<input type="checkbox"/>	0.00	0.00
WaterAvailabilityRisk	<input type="checkbox"/>		
RecreationEarlySeason	<input type="checkbox"/>		
RecreationLateSeason	<input type="checkbox"/>		

Derived Variables

Variable	Function
Recreation	[RecreationEarlySeason] + [RecreationLateSeason]

**NOTE: 100 iterations might be insufficient...**



# Viewing Monte Carlo Results

**Planning Sets**

Plan	Plan Description	Cost (Mean)	Output (Mean)	WaterAvailabilityRisk (Mean)	Recreation (Mean)	RecreationEarlySeason (Mean)	RecreationLate
No Action Plan	Default No Action Plan	\$0.00	0	0	0	0	0
Red Plan	Extensive Construction, Active Mana	\$48,398					
Orange Plan	Extensive Construction, Passive Man	\$42,611					
Yellow Plan	Nature-Based, Active Management	\$37,021					
Green Plan	Nature-Based, Passive Management	\$30,346					
Blue Plan	Incremental Adaptive Construction	\$27,850					

**Uncertainty Reports and Graphs Viewer**

Planning Set Groups: UncertaintySetResults

Plan Alternatives to Graph: Recreation

Graphs:  All  Cost Effective  Best Buy

Reports:  All  Cost Effective  Best Buy

**CE Statistic Report**

Plan Name	Cost Effective	Best Buy
No Action Plan	0 / 20	0 / 20
A1B0C0	7 / 20	0 / 20
A2B0C0	10 / 20	0 / 20
A0B1C0	13 / 20	0 / 20
A0B2C0	13 / 20	0 / 20
A1B1C0	6 / 20	0 / 20
A2B1C0	11 / 20	0 / 20
A1B2C0	10 / 20	0 / 20
A2B2C0	6 / 20	0 / 20

**Tolerance Rule Violations**

Plan Name	Cost	Output
No Action Plan	0 / 20	0 / 20
A1B0C0	7 / 20	0 / 20
A2B0C0	10 / 20	0 / 20
A0B1C0	13 / 20	0 / 20
A0B2C0	13 / 20	0 / 20
A1B1C0	6 / 20	0 / 20
A2B1C0	11 / 20	0 / 20
A1B2C0	10 / 20	0 / 20
A2B2C0	6 / 20	0 / 20

**Correlation Matrix**

Input Correlation Matrix

	Cost	Output
Cost	1	0
Output	0	1

Output Correlation Matrix

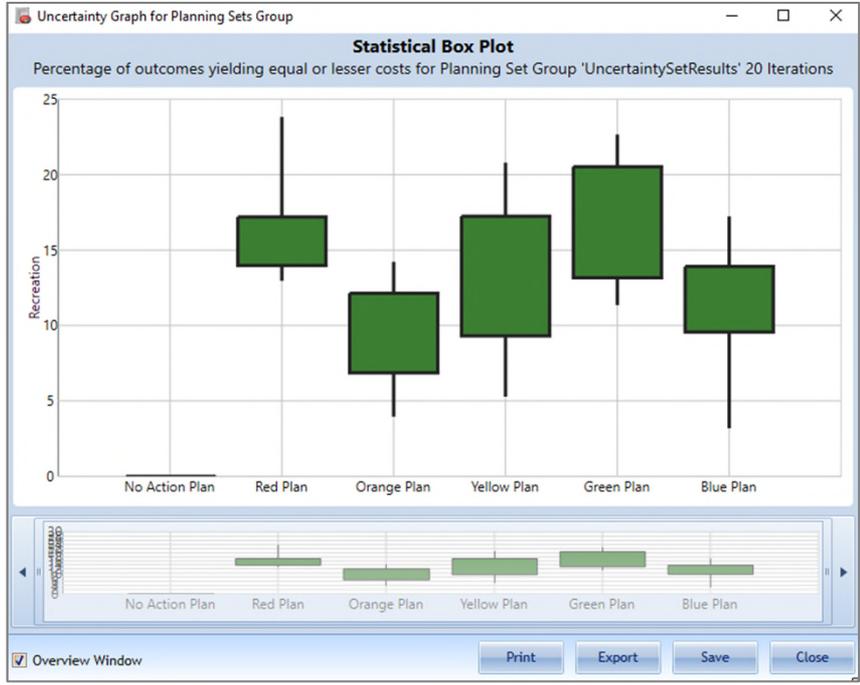
	Cost	Output
Cost	1	NaN
Output	NaN	1

Tables

Charts



# Viewing Monte Carlo Results



## Charts



# Viewing Monte Carlo Results

## Monte Carlo Uncertainty Cost Effective Statistics

Uncertainty Group 'UncertaintySetResults' 20 Iterations

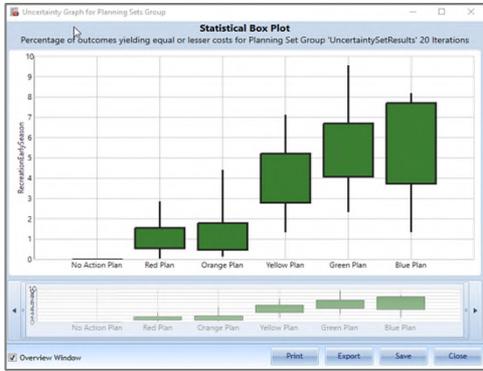
Plan	Variable	Avg	SD	Min	10 <sup>th</sup> %	25 <sup>th</sup> %	50 <sup>th</sup> %	75 <sup>th</sup> %	90 <sup>th</sup> %	Max
No Action Plan	• Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No Action Plan	• Output	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No Action Plan	• WaterAvailabilityRisk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No Action Plan	• Recreation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No Action Plan	• RecreationEarlySeason	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No Action Plan	• RecreationLateSeason	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Red Plan	Cost	48,398.20	3,131.18	42,978.39	45,245.75	46,460.63	47,979.14	50,002.70	51,874.59	56,015.81
Red Plan	Output	2,173.39	210.71	1,761.28	1,901.68	2,070.57	2,150.45	2,381.20	2,401.19	2,507.59
Red Plan	• WaterAvailabilityRisk	50.00	0.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Red Plan	• Recreation	15.96	2.77	12.96	13.48	14.11	14.82	16.80	19.95	23.83
Red Plan	RecreationEarlySeason	1.03	0.83	0.04	0.34	0.58	1.04	1.32	1.69	2.86
Red Plan	RecreationLateSeason	14.92	2.51	12.54	12.75	13.04	14.48	15.35	17.30	22.14
Orange Plan	Cost	42,611.96	2,846.30	36,760.40	37,700.09	40,514.77	43,497.22	45,043.08	45,572.09	45,812.93
Orange Plan	Output	2,000.55	276.84	1,553.53	1,641.65	1,752.19	2,022.68	2,182.07	2,369.68	2,526.75
Orange Plan	• WaterAvailabilityRisk	45.00	0.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Orange Plan	• Recreation	9.66	2.91	3.95	5.96	7.38	9.84	12.05	13.30	14.22
Orange Plan	RecreationEarlySeason	1.30	1.18	0.14	0.35	0.54	0.86	1.62	3.15	4.42
Orange Plan	RecreationLateSeason	8.36	3.07	3.35	3.59	6.19	8.69	10.99	11.65	13.73
Yellow Plan	Cost	37,021.88	1,910.31	33,557.08	34,831.80	35,914.97	36,682.93	38,015.23	39,538.00	41,215.64
Yellow Plan	Output	2,359.17	143.03	2,085.81	2,162.93	2,260.68	2,381.57	2,443.15	2,535.84	2,634.15
Yellow Plan	• WaterAvailabilityRisk	30.00	0.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Yellow Plan	• Recreation	14.04	4.16	5.28	8.73	10.12	15.13	16.74	18.79	20.79
Yellow Plan	RecreationEarlySeason	4.21	1.48	1.34	2.03	3.32	4.46	5.15	5.74	7.13
Yellow Plan	RecreationLateSeason	9.83	3.97	1.79	3.88	7.04	11.12	12.90	13.97	14.52
Green Plan	Cost	30,346.81	643.69	29,363.38	29,511.85	29,863.28	30,410.06	30,814.95	31,004.46	31,680.51
Green Plan	Output	2,105.42	300.77	1,557.41	1,613.03	1,887.08	2,178.26	2,364.67	2,438.71	2,476.12
Green Plan	• WaterAvailabilityRisk	25.00	0.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Green Plan	• Recreation	16.45	3.54	11.35	12.74	13.25	16.09	18.91	21.78	22.67
Green Plan	RecreationEarlySeason	5.55	1.89	2.33	3.25	4.23	5.54	6.46	8.02	9.56
Green Plan	RecreationLateSeason	10.91	3.01	5.36	7.23	8.19	11.00	13.24	15.05	15.96

# Tables



# Something to remember...

## Early Season

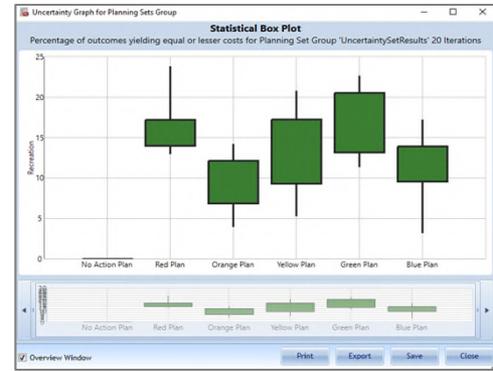


## Late Season



=

## Total Season



## Recall that we defined one variable as a formula.

Using the distributions and parameters entered by the user, the Recreation Outputs were computed for each iteration as a sum of the Early Season and Late Season Recreation outputs.

One reason to consider running more iterations...

Planning Study [IWRPSIIUncModWebinar] Properties

Name: IWRPSIIUncModWebinar

Description: This is a hypothetical planning set that has been developed to illustrate uses and mechanics of the IWR Planning Suite II Uncertainty Module.

Name	Units	Descrip
Cost	\$1000	Average
Output	Habitat Units	Output
WaterAvailabilityRisk	AvailabilityDe	Average
Recreation	AccessDays	Average
RecreationEarlySeason	AccessDays	Average
RecreationLateSeason	AccessDays	Average

Formula Editor - Derived Variable 'Recreation'

[RecreationEarlySeason] + [RecreationLateSeason]

Select Variables: Cost, Output, WaterAvailabilityRisk, RecreationEarlySeason, RecreationLateSeason

# Running Uncertainty-Informed CEICA

The screenshot displays the IWR Planning Suite II interface. The 'Perform CE/ICA' button on the ribbon is circled in red and labeled with a '1'. A blue arrow points to the 'UncertaintySetResults' item in the 'Uncertainty Sets' tree view. The 'Perform Uncertainty CE/ICA Analysis' dialog box is open, showing the 'Planning Set' dropdown set to 'UncertaintySetResults' (2). The 'Name' field contains 'UncertaintySetResults Cost v Output CEICA' (2), and the 'Description' field contains 'Planning set generated by Cost Effective/Incremental Cost Analysis' (2). In the 'CE/ICA Analysis' section, the 'Cost Variable' dropdown is set to 'Cost' (3), and the 'Output Variable' dropdown is set to 'Output' (4). The 'Output' option is highlighted in the dropdown list. The 'Perform Data Envelopment Analysis' and 'Exclude plans in violation of tolerance rules' checkboxes are checked. The 'Analyze' button is circled in red and labeled with a '5'.

A CEICA will be performed on each of the possibilities generated by the Monte Carlo engine to identify cost-effective and “best buy” plans for each iteration.

# Viewing Your CEICA Results

The screenshot shows the IWR Planning Suite II interface. The 'Graphs & Reports' button is highlighted with a red box. The 'Uncertainty Reports and Graphs Viewer' window is open, displaying the following components:

- CE and BB Counts by Plan:** A table showing the number of Cost Effective (CE) and Best Buy (BB) plans for each alternative.
- Correlation Matrix:** A table showing the correlation between Cost and Output variables.
- Tolerance Rule Violations:** A table showing the number of violations for each plan.
- Statistical Box Plot:** A chart showing the distribution of the Cost variable for each plan.
- Exceedance Curve Graph:** A chart showing the probability of exceeding a given cost threshold for each plan.
- Cost Effective Frequency:** A pie chart showing the frequency of cost-effective plans for each alternative.
- Cartesian (Cost, Output) Graph:** A scatter plot showing the relationship between Cost and Output for each plan.
- Cost Effective Line Graph:** A line graph showing the cost-effective frequency for each plan.
- Cost Effective Bar Graph:** A bar chart showing the cost-effective frequency for each plan.

Tables

Charts

You will see that several chart options are now available...  
**Which plans were cost effective and/or best-buys most often?**



# Viewing Your CEICA Results

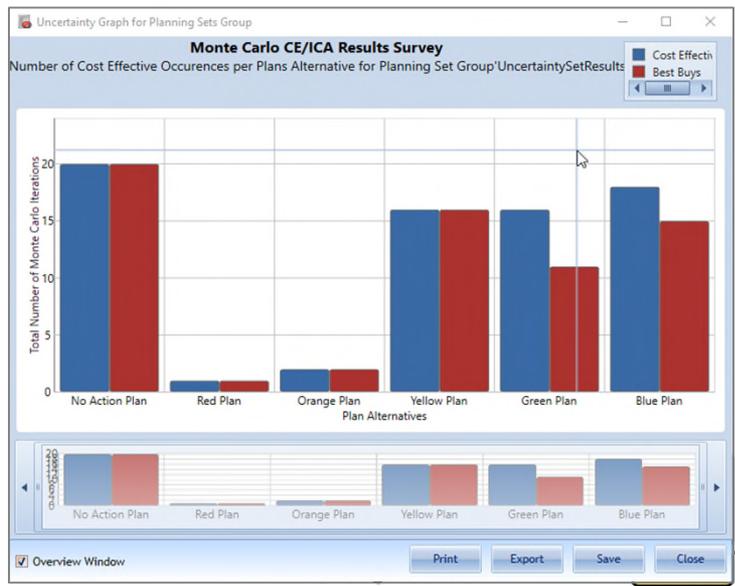
## Table

### Uncertainty Cost Effective Report: 20 Iterations

Uncertainty Group 'UncertaintySetResults Cost v Output CEICA 15 (CEICA)'  
0 plan alternatives were removed; not cost effective in any iteration.

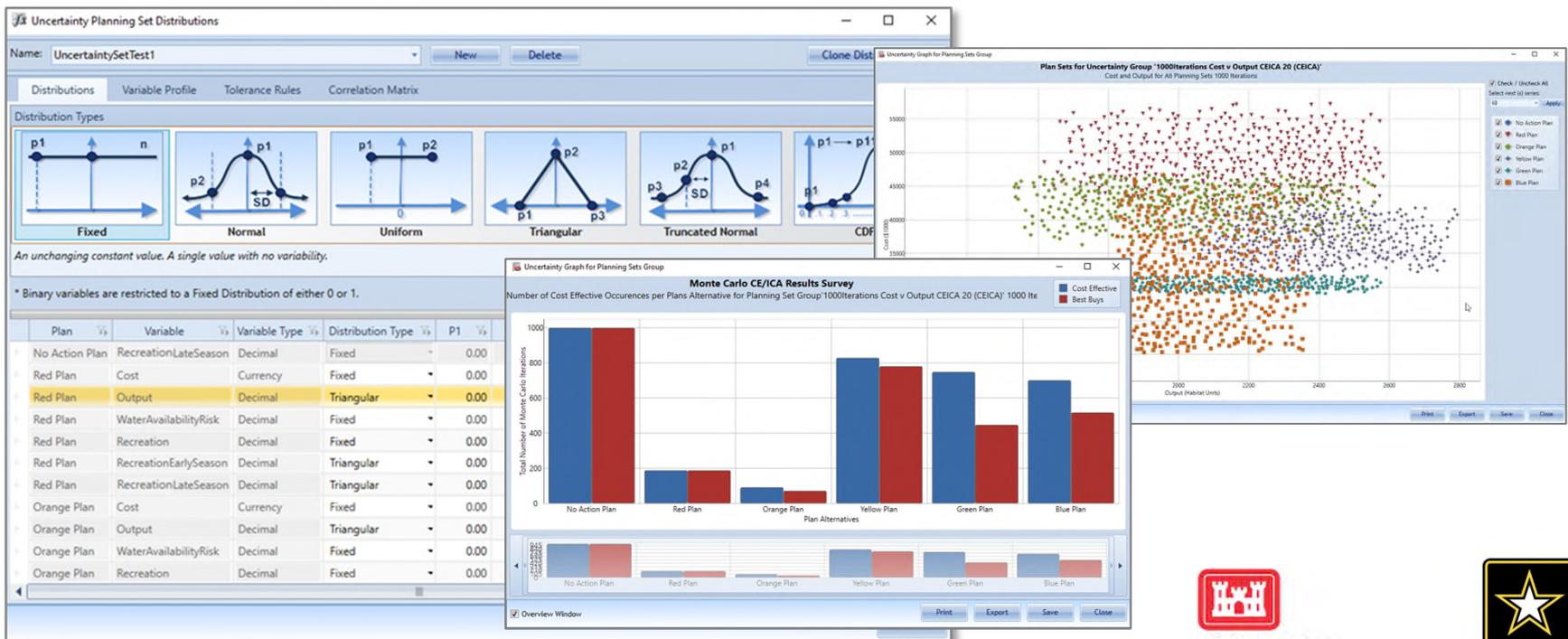
<u>Plan Name</u>	<u>Cost Effective</u>	<u>Best Buy</u>
No Action Plan	20 / 20	20 / 20
Red Plan	1 / 20	1 / 20
Orange Plan	2 / 20	2 / 20
Yellow Plan	16 / 20	16 / 20
Green Plan	16 / 20	11 / 20
Blue Plan	18 / 20	15 / 20

## Charts



# A Few Endnotes...

- **Tolerance Rules Tab** – In an effort to manage the volume of data generated by the Monte Carlo engine, tolerances for “acceptability” can be assigned by users. The planning suite will track and report how frequently the value for a variable was outside of the user-specified range.
- **Correlation Matrix** – An option exists for users to assign correlation coefficients between variables that are not independent of one another.



US Army Corps  
of Engineers.



# TRAINING RESOURCES & HELP

- Links to the software, certification memo, and other related resources can be found at <http://www.iwr.usace.army.mil/Missions/Economics/IWR-Planning-Suite/>.
- Training materials that highlight IWR Planning Suite's capabilities, improvements and case study applications are available online at the [IWR Planning Assistance Library](#).
- Customized or study-specific training/assistance is also available upon request. For Support, Please contact:
  - IWR Planning Suite Development Team at: **DLL-CEIWR\_IWR-PLAN**; or
  - ECO-PCX



# Discussion?

Type questions in the chat box.  
We will answer as many  
as time allows.

This webinar will be posted to the  
Planning Community Toolbox:  
<http://www.corpsplanning.us>



**US Army Corps  
of Engineers**

