Introduction to River Architect

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Project Maker: Cost-Benefit Analysis

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Project Maker

Uses spatial subsets of two Conditions to evaluate Costs and Gain in SHArea through the transition from the initial Condition to a remodeled Condition.

Lifespan mapping, SHArC & some project shapefiles must be prepared before running *Project Maker*:

- Spatial subset is defined in ProjectArea.shp:
  https://riverarchitect.github.io/RA_wiki/ProjectMaker#pminp2
- Existing vegetation is defined in PlantExisting.shp:
  https://riverarchitect.github.io/RA_wiki/ProjectMaker#pminp3
- Existing vegetation that must be removed for terraforming is defined in PlantClearing.shp:
  https://riverarchitect.github.io/RA_wiki/ProjectMaker#pminp31

The required shapefiles are provided for this workshop: **/workshop_data/project_files/** and must be prepared otherwise manually.

Project Maker GUI

https://riverarchitect.github.io/RA_wiki/ProjectMaker

1) Version your project (for example: v01)

2) Define Project name (for example: NewbaRiver)

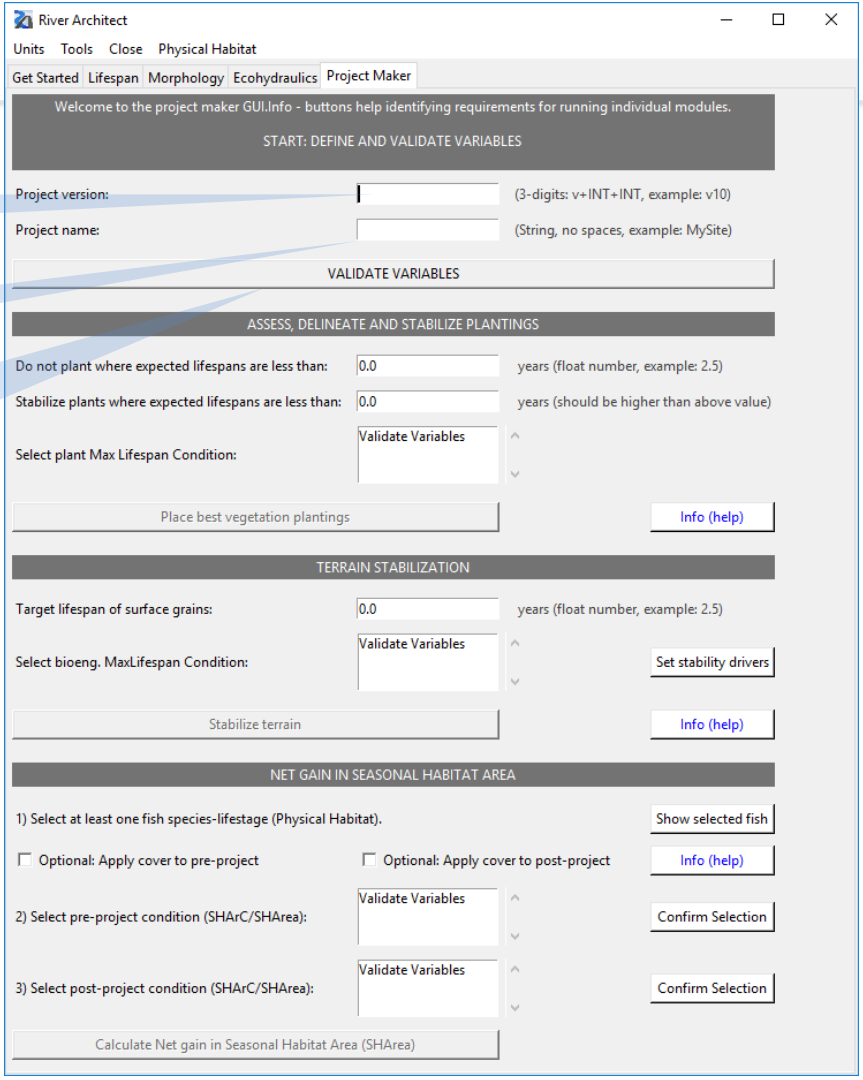
3) VALIDATE VARIABLES

Creates ProjectMaker/NewbaRiver_v01/ folder with:

- Geodata/ –Shapefiles –Rasters –SHArea_eval…xlsx
- NewbaRiver_assessment_v01.xlsx
- ProjectMaps.aprx

Click OK to open the two latter files automatically (recommended).

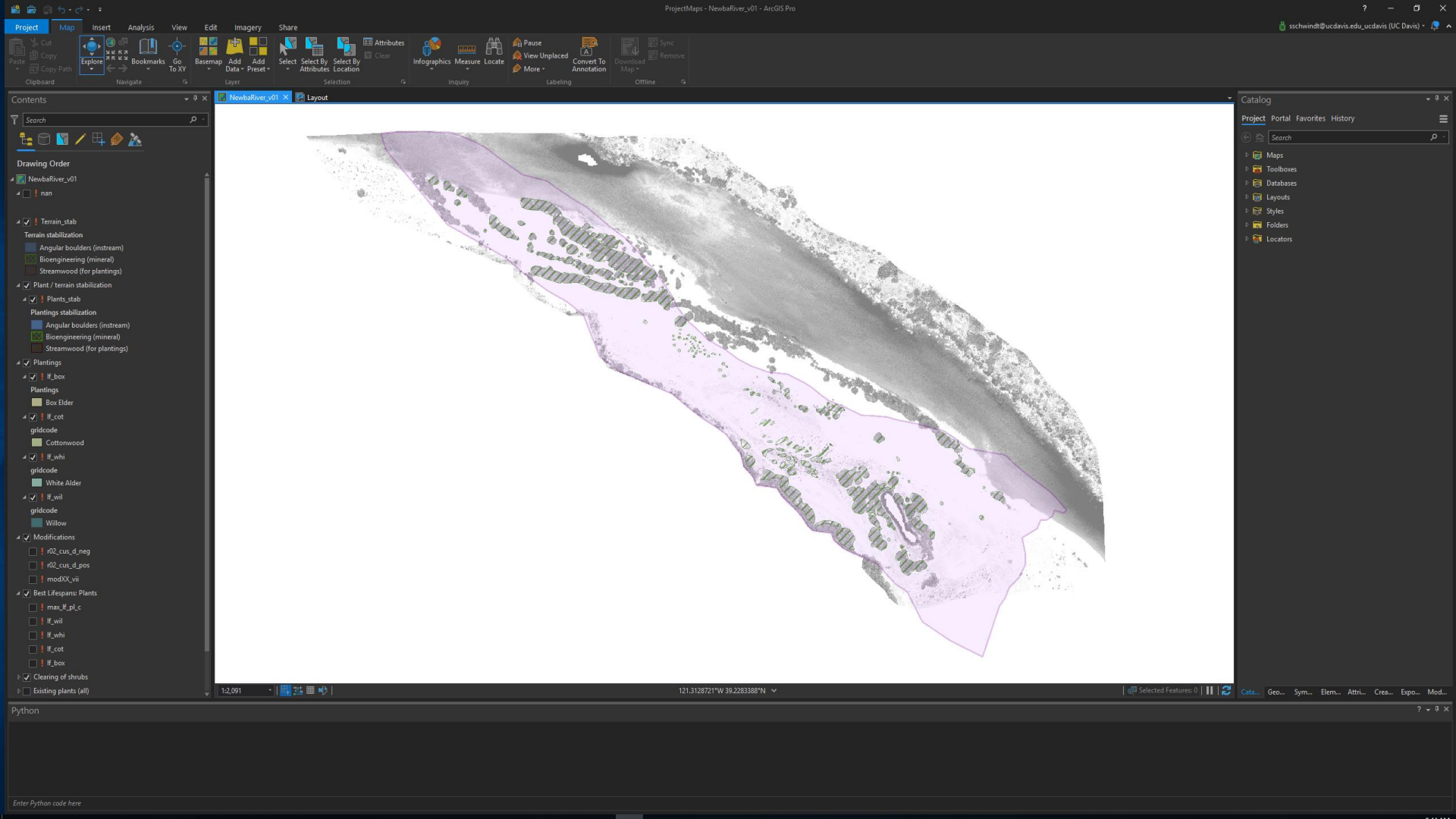
Project Maker → Startup



Prepare Project

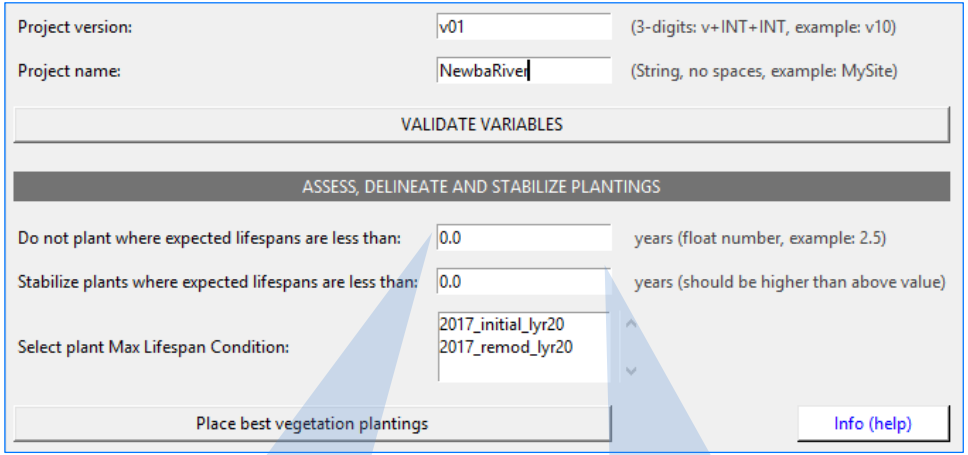
1. Copy ProjectArea.shp, PlantExisting.shp & PlantClearing.shp to ProjectMaker/NewbaRiver_v01/Geodata/Shapefiles
2. In ArcGIS (ProjectMaps.aprx – automatically opened)
   - Rename map from NAME_vii to NewbaRiver_v01
   - Define sources of the following layers:
     - background = 01_Conditions/INITIAL/back.tif
     - Project area = ProjectMaker/NewbaRiver_v01/Geodata/Shapefiles/ProjectArea.shp
     - Existing plants = ProjectMaker/NewbaRiver_v01/Geodata/Shapefiles/PlantExisting.shp
     - Clearing of shrubs = ProjectMaker/NewbaRiver_v01/Geodata/Shapefiles/PlantClearing.shp
   - Right-click on Project area and select Zoom to layer
   - Save & close ProjectMaps.aprx
3. In ProjectMaker/NewbaRiver_v01/NewbaRiver_assessment_v01.xlsx and
   - define Site name (Cell C3) = "…" (e.g., New Bar Bend)
   - Delete tab "costs (SI metric)"
   - Save & close workbook

Hint: Closing & re-opening the .aprx project file after copying the shapefiles does most of the job.


ProjectMaps - NewbaRiver_v01 - ArcGIS Pro
Project
Map
Insert
Analysis
View
Edit
Imagery
Share
sschwindt@ucdavis.edu_ucdavis (UC Davis)
Paste
Cut
Copy
Copy Path
Clipboard
Explore
Bookmarks
Go To XY
Navigate
Basemap
Add Data
Add Preset
Layer
Select
Select By Attributes
Select By Location
Attributes
Clear
Selection
Infographics
Measure
Locate
Inquiry
Pause
View Unplaced
More
Convert To Annotation
Labeling
Download Map
Sync
Remove
Offline
Contents
Search
Drawing Order
NewbaRiver_v01
nan
Terrain_stab
Terrain stabilization
Angular boulders (instream)
Bioengineering (mineral)
Streamwood (for plantings)
Plant / terrain stabilization
Plants_stab
Plantings stabilization
Angular boulders (instream)
Bioengineering (mineral)
Streamwood (for plantings)
Plantings
lf_box
Plantings
Box Elder
lf_cot
gridcode
Cottonwood
lf_whi
gridcode
White Alder
lf_wil
gridcode
Willow
Modifications
r02_cus_d_neg
r02_cus_d_pos
modXX_vii
Best Lifespans: Plants
max_lf_pl_c
lf_wil
lf_whi
lf_cot
lf_box
Clearing of shrubs
Existing plants (all)
NewbaRiver_v01
Layout
1:2,091
121.3128721°W 39.2283388°N
Selected Features: 0
Catalog
Project
Portal
Favorites
History
Search
Maps
Toolboxes
Databases
Layouts
Styles
Folders
Locators
Cata...
Geo...
Sym...
Elem...
Attri...
Crea...
Expo...
Mod...
Python
Enter Python code here

Project Maker GUI

- Creates shapefiles & rasters in the ProjectMaker/NewbaRiver_v01/Geodata/ folder
- Exports quantities (plant surfaces) to the ProjectMaker/NewbaRiver_v01/Quantities/ folder
- Writes quantities (plant surfaces) to ProjectMaker/NewbaRiver_v01/NewbaRiver_assessment_v01.xlsx (and opens the workbook)

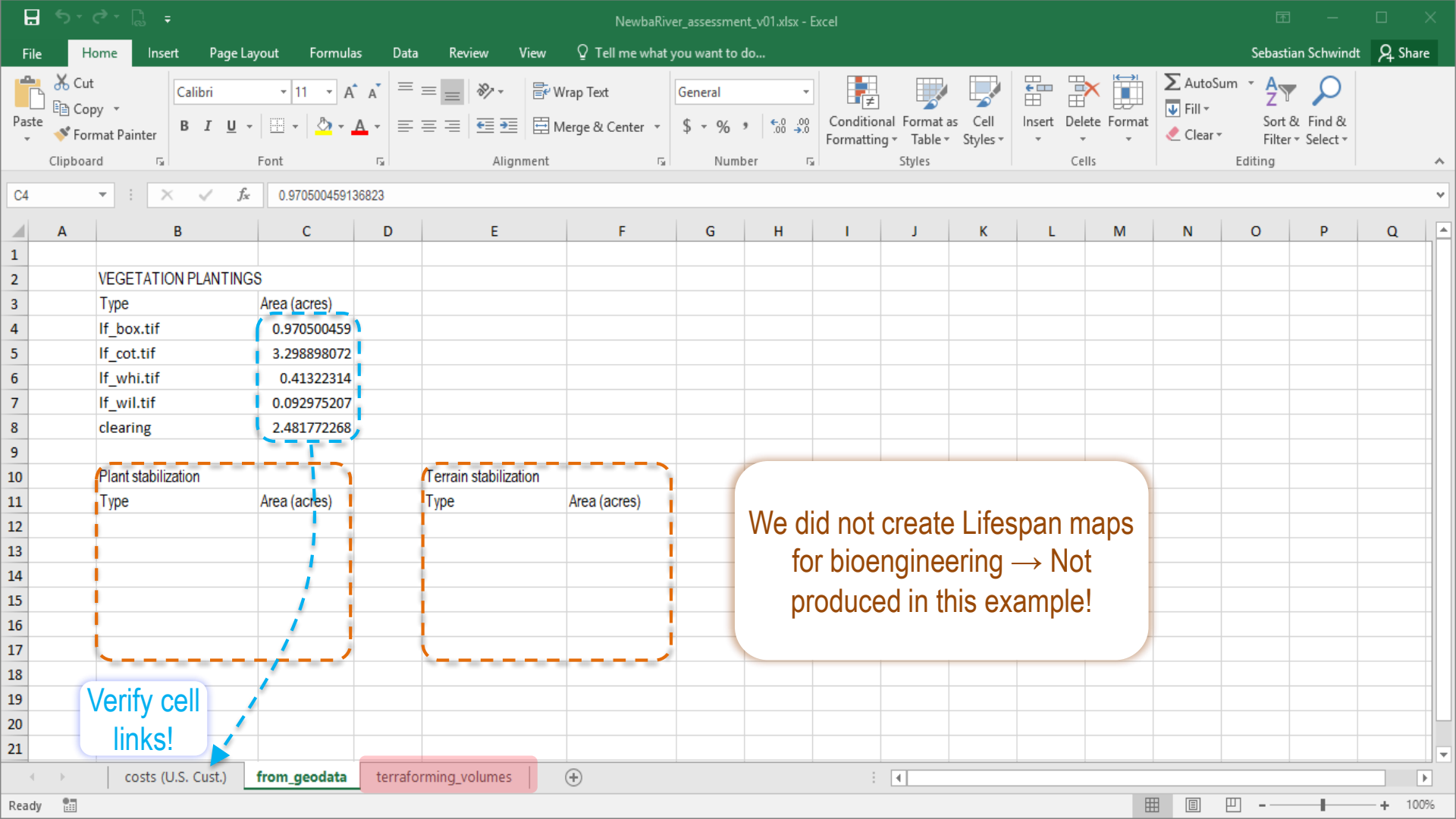


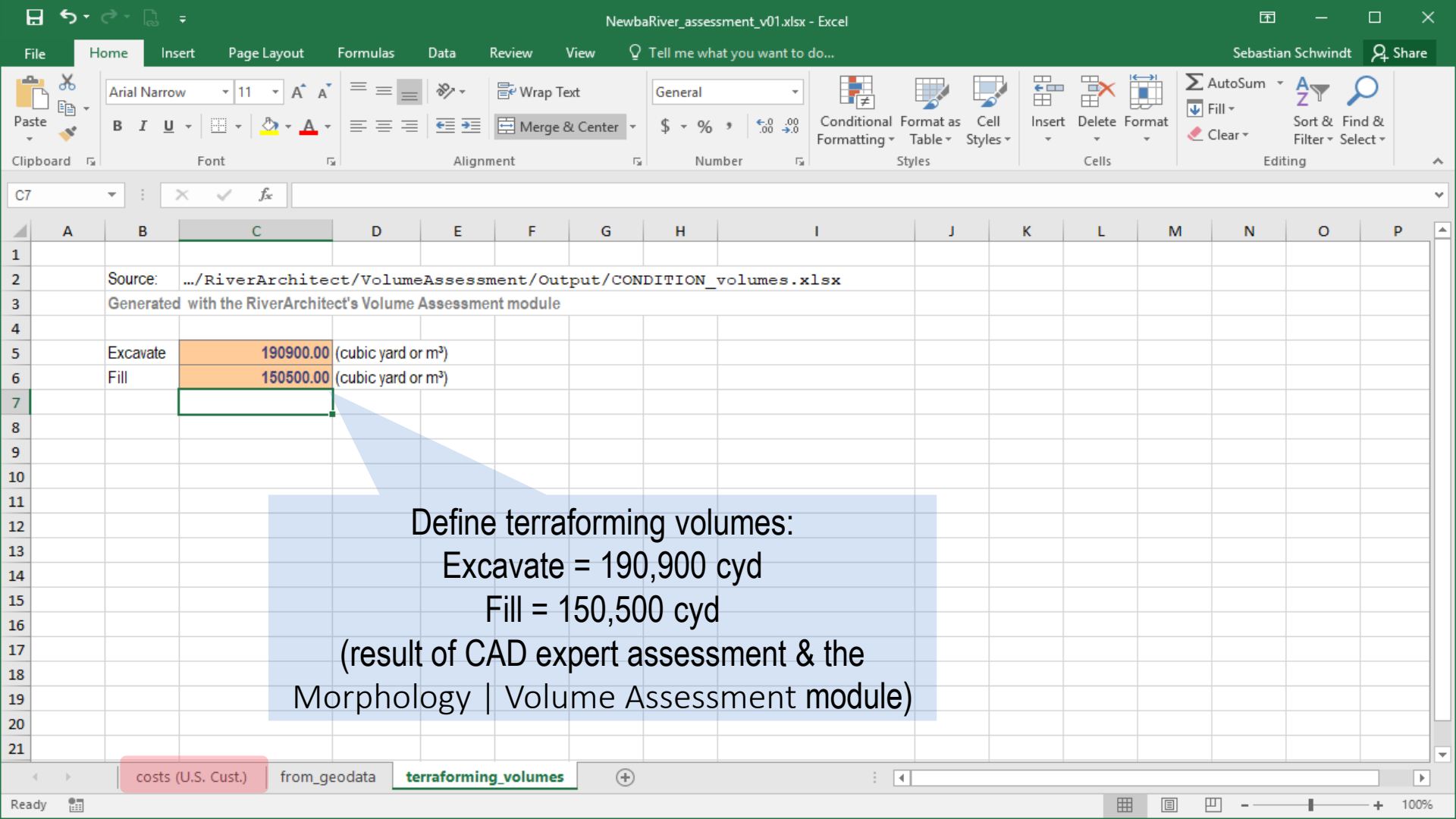
1) Set no plantings lifespan to 2.0

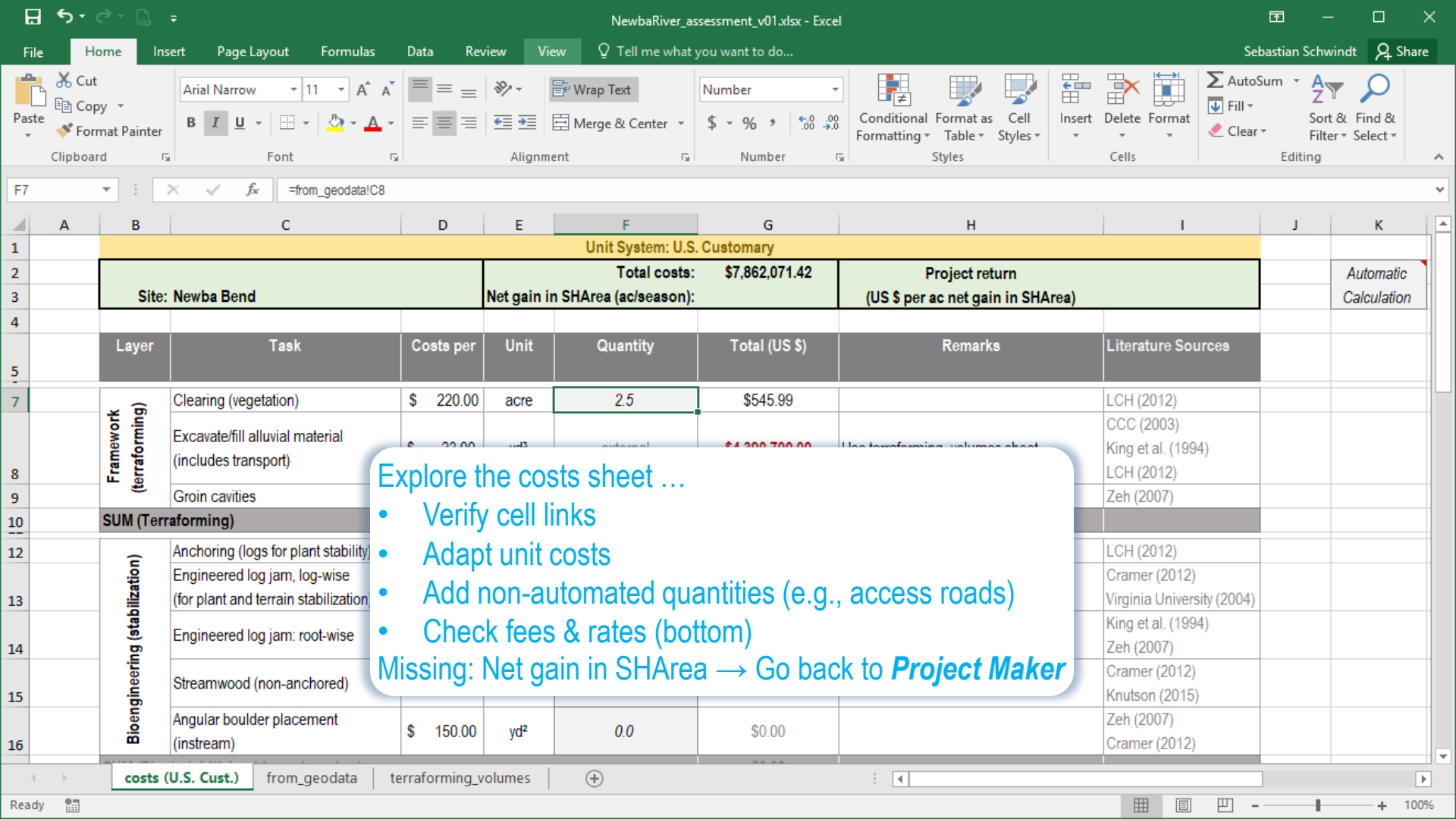
2) Set plant stabilization to 5.0

3) Select remod condition & click on Place best vegetation plantings

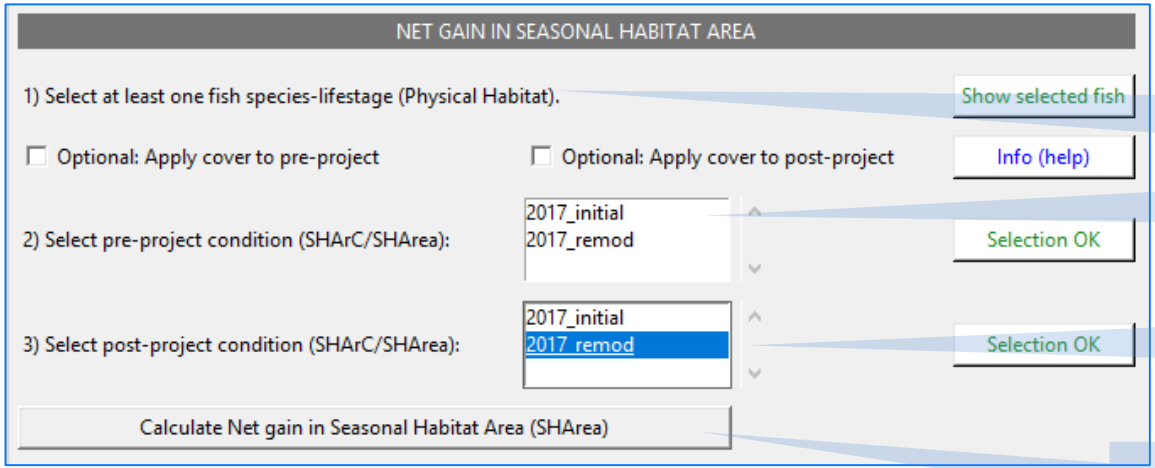
```
Looking up specific bioengineering lifespan rasters ...
D:\temp\RA_workshop\ProjectMaker\NewbaRiver_v01\Geodata\Rasters\lf_wood.tif
WARNING: Could not find Lifespan Raster (D:\temp\RA_workshop\LifespanDesign\Output\Rasters\2017_remod_lyr20\lf_wood.tif).
         > Go to the Lifespan Tab and create lifespan rasters for the Bioengineering feature group.
         > Applying 0-lifespans instead.
WARNING: Could not find Lifespan Raster (D:\temp\RA_workshop\LifespanDesign\Output\Rasters\2017_remod_lyr20\lf_bio_v_bio.tif).
         > Go to the Lifespan Tab and create lifespan rasters for the Bioengineering feature group.
         > Applying 0-lifespans instead.
 -- OK (Bioengineering raster read)
Assessing best features for plant stabilization.
ERROR: Best stabilization assessment failed.
```


NewbaRiver_assessment_v01.xlsx - Excel
File
Home
Insert
Page Layout
Formulas
Data
Review
View
Tell me what you want to do...
Sebastian Schwindt
Share
Cut
Copy
Format Painter
Paste
Clipboard
Calibri
11
Font
Wrap Text
Merge & Center
Alignment
General
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
Cells
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Editing
C4
0.970500459136823
VEGETATION PLANTINGS
Type
Area (acres)
lf_box.tif
0.970500459
lf_cot.tif
3.298898072
lf_whi.tif
0.41322314
lf_wil.tif
0.092975207
clearing
2.481772268
Plant stabilization
Type
Area (acres)
Terrain stabilization
Type
Area (acres)
We did not create Lifespan maps for bioengineering → Not produced in this example!
Verify cell links!
costs (U.S. Cust.)
from_geodata
terraforming_volumes
Ready
100%


NewbaRiver_assessment_v01.xlsx - Excel
File
Home
Insert
Page Layout
Formulas
Data
Review
View
Tell me what you want to do...
Sebastian Schwindt
Share
Paste
Arial Narrow
11
Wrap Text
Merge & Center
General
Conditional Formatting
Format as Table
Cell Styles
Insert
Delete
Format
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Clipboard
Font
Alignment
Number
Styles
Cells
Editing
C7
Source: .../RiverArchitect/VolumeAssessment/Output/CONDITION_volumes.xlsx
Generated with the RiverArchitect's Volume Assessment module
Excavate 190900.00 (cubic yard or m³)
Fill 150500.00 (cubic yard or m³)
Define terraforming volumes:
Excavate = 190,900 cyd
Fill = 150,500 cyd
(result of CAD expert assessment & the
Morphology | Volume Assessment module)
costs (U.S. Cust.)
from_geodata
terraforming_volumes
Ready
100%


NewbaRiver_assessment_v01.xlsx - Excel
File Home Insert Page Layout Formulas Data Review View Tell me what you want to do... Sebastian Schwindt Share
Cut Copy Format Painter Paste Clipboard
Arial Narrow 11 Font
Wrap Text Merge & Center Alignment
Number
Conditional Formatting Format as Table Cell Styles Styles
Insert Delete Format Cells
AutoSum Fill Clear Sort & Filter Find & Select Editing
F7 =from_geodata!C8
Unit System: U.S. Customary
Site: Newba Bend
Total costs: $7,862,071.42
Net gain in SHArea (ac/season):
Project return (US $ per ac net gain in SHArea)
Automatic Calculation
Layer Task Costs per Unit Quantity Total (US $) Remarks Literature Sources
Framework (terraforming)
Clearing (vegetation) $ 220.00 acre 2.5 $545.99 LCH (2012)
Excavate/fill alluvial material (includes transport) CCC (2003) King et al. (1994) LCH (2012)
Groin cavities Zeh (2007)
SUM (Terraforming)
Bioengineering (stabilization)
Anchoring (logs for plant stability) LCH (2012)
Engineered log jam, log-wise (for plant and terrain stabilization) Cramer (2012) Virginia University (2004)
Engineered log jam: root-wise King et al. (1994) Zeh (2007)
Streamwood (non-anchored) Cramer (2012) Knutson (2015)
Angular boulder placement (instream) $ 150.00 yd² 0.0 $0.00 Zeh (2007) Cramer (2012)
Explore the costs sheet …
• Verify cell links
• Adapt unit costs
• Add non-automated quantities (e.g., access roads)
• Check fees & rates (bottom)
Missing: Net gain in SHArea → Go back to Project Maker
costs (U.S. Cust.) from_geodata terraforming_volumes
Ready 100%

Project Maker GUI (bottom)



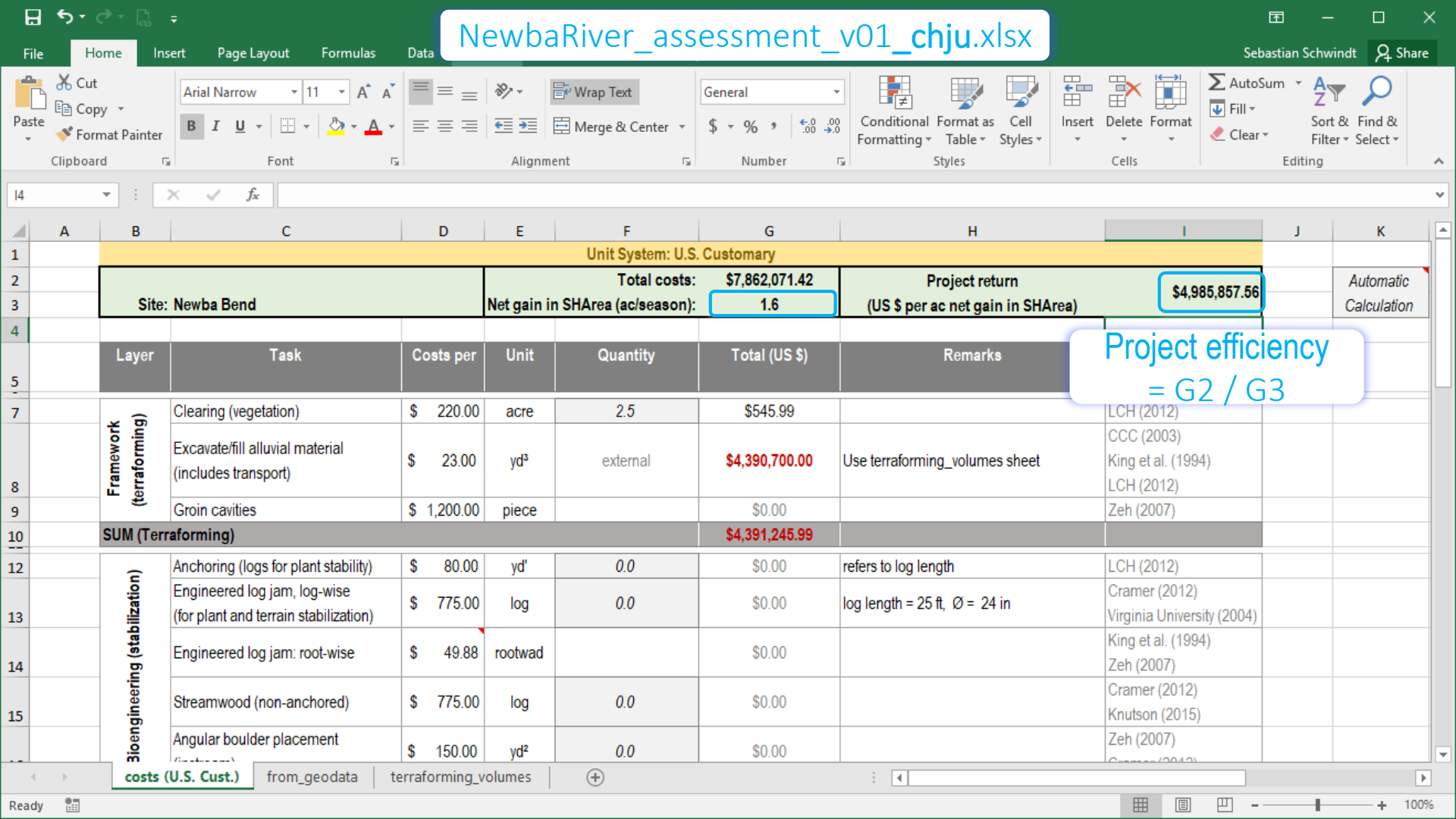
1) Select from TOP menu Physical Habitat > Chinook salmon – juvenile

2) Set pre-project to initial condition & click Select button

3) Set post-project to remod condition & click Select button

4) Click on Calculate Net gain … (SHArea)

- Writes gain in SHArea to ProjectMaker/NewbaRiver_v01/NewbaRiver_assessment_v01_chju.xlsx (Cell G3 and opens the workbook) – note: the formula in cell I3 breaks sometimes (I3 = G2 / G3)
- Write tables of Usable Habitat Area to ProjectMaker/NewbaRiver_v01/Geodata/SHArea_chju.xlsx (Usable Area – Discharge relations for initial & remod conditions)


NewbaRiver_assessment_v01_chju.xlsx
File
Home
Insert
Page Layout
Formulas
Data
Sebastian Schwindt
Share
Unit System: U.S. Customary
Total costs: $7,862,071.42
Project return
$4,985,857.56
Site: Newba Bend
Net gain in SHArea (ac/season): 1.6
(US $ per ac net gain in SHArea)
Automatic Calculation
Project efficiency
= G2 / G3
Layer
Task
Costs per
Unit
Quantity
Total (US $)
Remarks
Framework (terraforming)
Clearing (vegetation)
$ 220.00
acre
2.5
$545.99
LCH (2012)
Excavate/fill alluvial material (includes transport)
$ 23.00
yd³
external
$4,390,700.00
Use terraforming_volumes sheet
CCC (2003)
King et al. (1994)
LCH (2012)
Groin cavities
$ 1,200.00
piece
$0.00
Zeh (2007)
SUM (Terraforming)
$4,391,245.99
Bioengineering (stabilization)
Anchoring (logs for plant stability)
$ 80.00
yd'
0.0
$0.00
refers to log length
LCH (2012)
Engineered log jam, log-wise (for plant and terrain stabilization)
$ 775.00
log
0.0
$0.00
log length = 25 ft, Ø = 24 in
Cramer (2012)
Virginia University (2004)
Engineered log jam: root-wise
$ 49.88
rootwad
$0.00
King et al. (1994)
Zeh (2007)
Streamwood (non-anchored)
$ 775.00
log
0.0
$0.00
Cramer (2012)
Knutson (2015)
Angular boulder placement
$ 150.00
yd²
0.0
$0.00
Zeh (2007)
costs (U.S. Cust.)
from_geodata
terraforming_volumes
Ready
100%

M10

Total SHArea o	Initial (existing)	1.1	(ac/season)
Total SHArea o	With implementation	2.7	(ac/season)
Net SHArea	(difference)	1.6	(ac/season)

Initial (existing)			
Discharge	Exceedance duration	Usable Area	SHArea
(cfs)	(% of a season - cum.)	(ac)	(ac/season/Q)
166954	0	1.050275482	0
147510	0	1.119146006	0
125012	0	0.928030303	0
97419	0	0.515381084	0
80686	0	0.357552801	0
60514	0	0.499311295	0
34104	0	0.8	0
11494	0.095612905	1.3	0.001238819
5984	1.175332262	0.5	0.00586707
5000	1.898856519	0.6	0.004007786
04000	4.017216643	0.6	0.012701407
03455	7.629618811	0.7	0.024644942
03000	9.01750506	0.8	0.011105958
02255	14.72177596	0.9	0.053707361

With implementation			
Discharge	Exceedance duration	Usable Area	SHArea
(cfs)	(% of a season - cum.)	(ac)	(ac/season/Q)
166954	0	0.767332415	0
147510	0	0.895316804	0
125012	0	1.074380165	0
97419	0	0.737488522	0
80686	0	0.713957759	0
60514	0	0.7478191	0
34104	0	0.740358127	0
11494	0.095612905	1.174380165	0.001122859
5984	1.175332262	1.658471074	0.017906833
5000	1.898856519	1.614876033	0.01168402
4000	4.017216643	2.171280992	0.045995551
3455	7.629618811	2.479958678	0.089586081
3000	9.01750506	2.776652893	0.038536784
2255	14.72177596	3.082644628	0.1758424

summary

Detailed documentation & reading for this chapter
https://riverarchitect.github.io/RA_wiki/ProjectMaker