TABLES & FIGURES

Table 4-1 SFC: Key Features of Hydrostratigraphic Units

Southern Franklin County Study Area

	Symbol	Unit Name	Unit Description	Horizontal Hydraulic Conductivity (ft/day)	Thickness (ft)	Storage Coefficient
Quaternary Deposits	Qa	Quaternary Alluvium	Talus, dunes, modern fluvial deposits, loess.	Dune sands and fluvial deposits are inferred by GWMA to be like Qf deposits.	Variable, generally less than 10 feet.	Variable by lithology.
	Qf	Pasco Gravels	Coarse gravel unit of Qf. Locally known as Pasco Gravels, equivalent to Hanford Gravels west of the Columbia River. Widespread in study area.	Ranges 73,000 to 48; median is 880. GWMA cites 2,000 to 25,000 ft/day, with eff porosity grater than 10%.	0 to 200 feet thick.	0.15 to 0.20 unconfined; 0.03 to 0.07 (confined)
Ringold Formation	PPl	Plio-Pleistocene caliche deposits	Generally less than 10 foot thick zone of caliche at upper contact of Columbia River Basalts and Ringold Formation.	"Low to Moderate", variable, not quantified. Assumed similar to substrate conductivity.	Generally less than 10 ft.	Variable, lower than uncemented portions of host lithology.
	Trf	Upper Ringold Formation	Interbedded silty-sandy deposits. Type locality in study area along White Bluffs	Ranges from 210 to 1.5; median is 25. Drost states range of 1.5 to 11 most reasonable unit average.	0 to 450 feet thick at White Bluffs	0.7 to 0.21 unconfined
	Trm	Middle Ringold Formation	Tan, sandy gravelly subunit of the Wooded Island Member.	Ranges from 5,000 to 7.5; median is 180	0 to 200 feet thick.	0.11 unconfined; 0.00007 to 0.06 (confined to semi-confined)
	Trl	Lower Ringold Formation	Silty, "muddy" subunit of the Wooded Island Member.	Ranges from 230 to 2.2; median is 46. Average similar to Trf.	0 to 100 feet thick.	0.02 to 0.21 unconfined; 0.002 to 0.05 (confined to semi-confined)
	Trb	Basal Ringold Formation	Gravelly subunit of the Wooded Island Member.	Assumed similar to Trm	0 to 5 feet thick.	Similar to Middle Ringold
Saddle Mountain Basalt	Tih	Ice Harbor Basalt	Ice Harbor member of the Saddle Mountain Basalt. Crops out in the eastern boundary of the study area, and is youngest basalt in study area.	Ranges from 3200 to 0.0073; median is 2.3	0 to 150 feet thick.	
	Tel	Levey Interbed - Ellensburg Formation	Continental sediments present between Tem and Tih.	Assumed 100 ft/day for conductive layers based on studies in other areas. Variable depending on lithology including claystone through sandstone facies.	0 to 100 feet thick. Generally 20 to 40 feet thick.	
	Tem	Elephant Mountain Basalt	Elephant Mountain member of the Saddle Mountain Basalt. Crops out in the eastern boundary of the study area.	Ranges from 3200 to 0.0073; median is 2.3	0 to 200 feet thick.	
	Trr	Rattlesnake Ridge member of Ellensburg Formation	Continental sediments present between Tem and Tp.	Assumed 100 ft/day for conductive layers based on studies in other areas. Variable depending on lithology including claystone through sandstone facies.	0 to 80 feet thick.	
	Tp	Pomona Basalt	Elephant Mountain member of the Saddle Mountain Basalt. Crops out in limited locations in eastern portion of study area.	Ranges from 3200 to 0.0073; median is 2.3	0 to 200 feet thick.	

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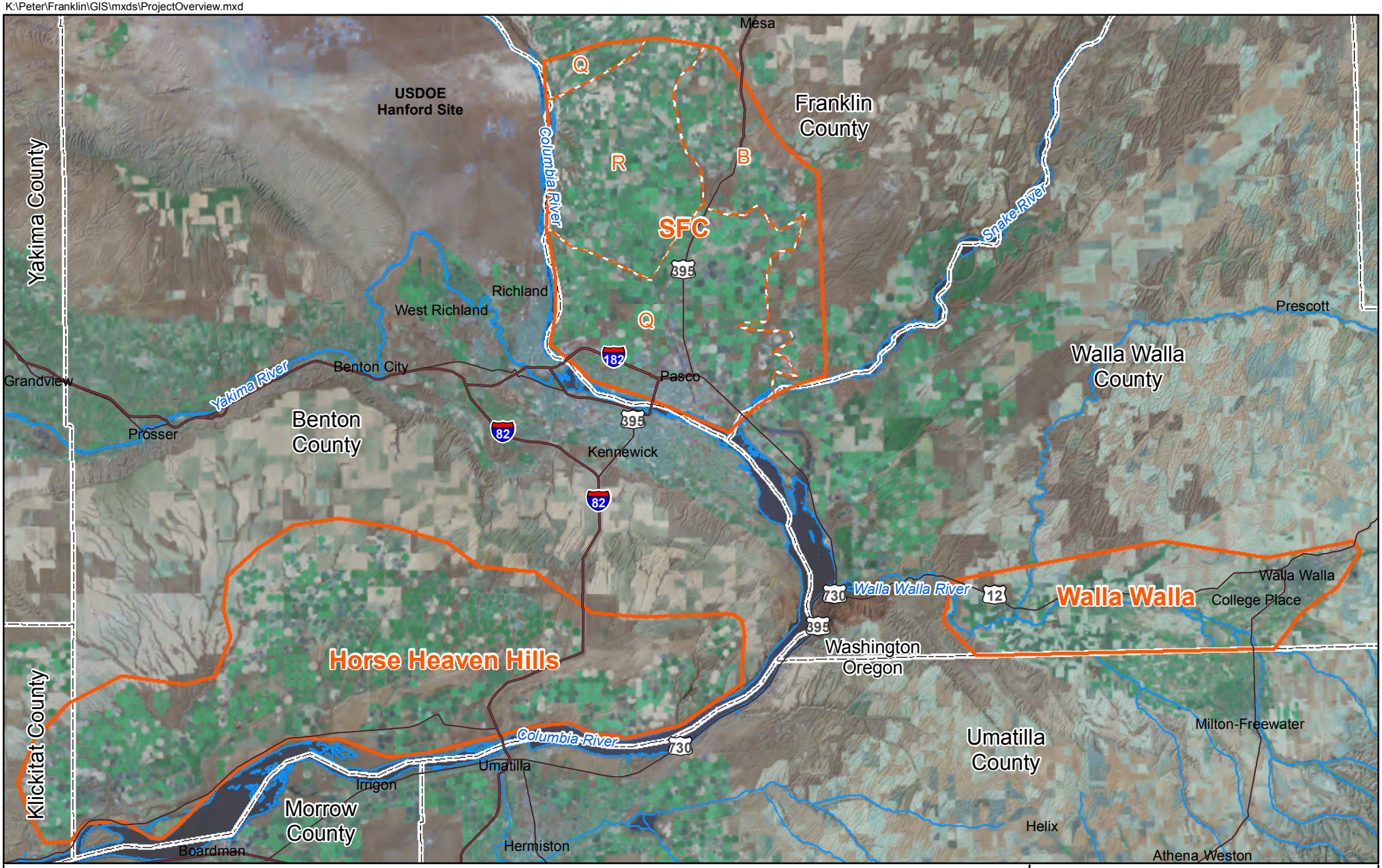


Study Areas

Southern Franklin County (SFC) Provinces

Q = Quaternary
R = Upper Ringold
B = Basalt

0 Miles 10

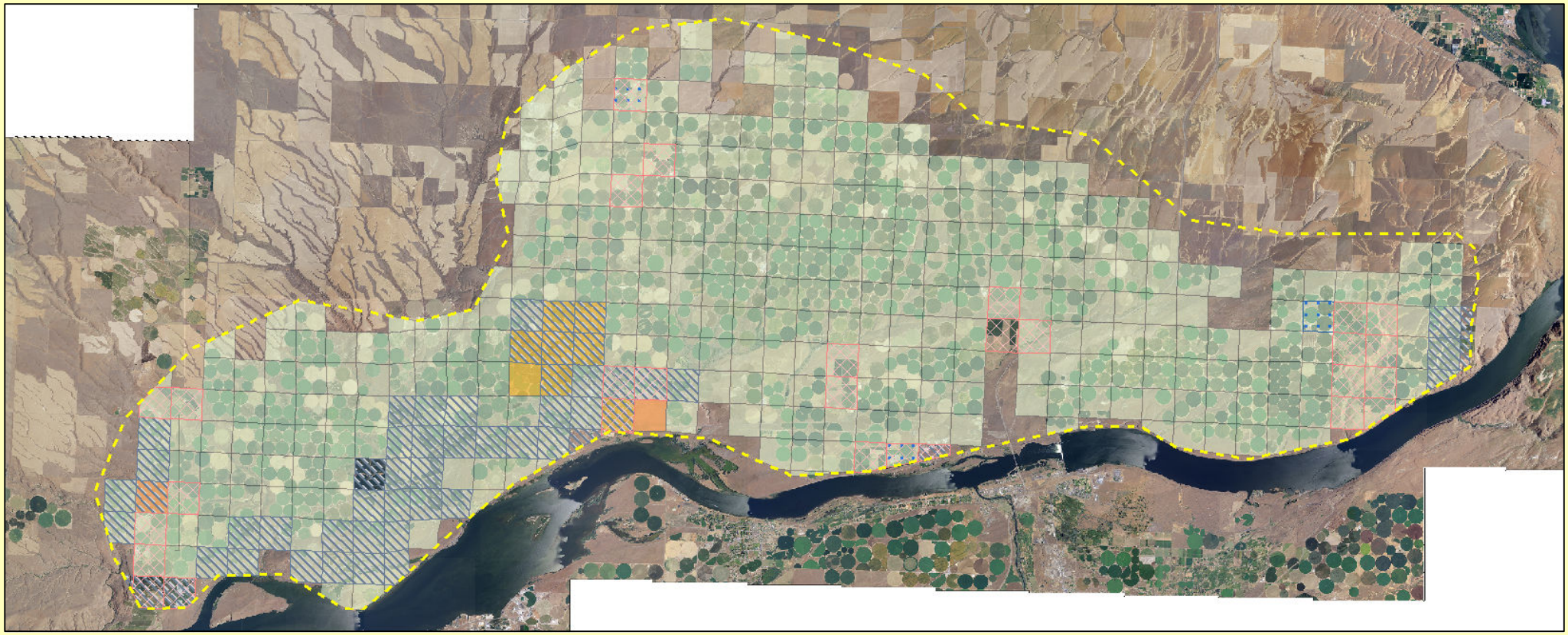
N

Figure 1-1
Study Areas

Franklin Conservation District
Retiming Benefits Analysis

PgG

Franklin Conservation District
Retiming Benefits Analysis



Legend

- Project Area
- Sections with Wheelline Irrigation
- Sections with Drip Irrigation
- Sections with Sprinkler Irrigation
- Sections with Other Forms of Irrigation
- Sections with Drip/Sprinkler Irrigation
- Sections with Center Pivot Irrigation

Figure 3-1
Irrigated Acreage in the Horse Heaven Hills Study Areas

N

1 INCH = 16,000 FEET

16,000 Feet

DRAWING IS NOT TO SCALE
IF BAR IS NOT 1" LONG

RH2

REV DATE: OCT 14, 2010

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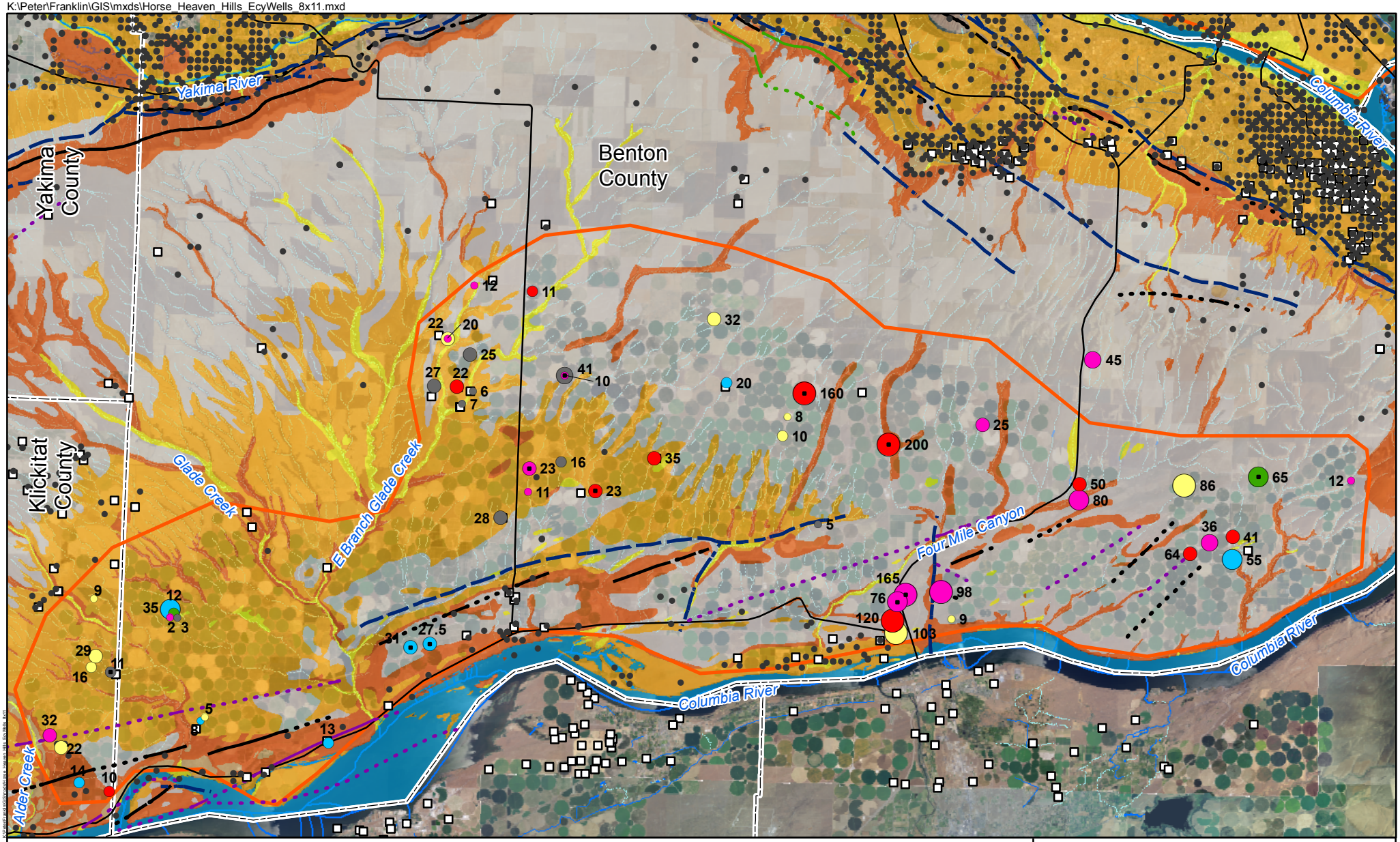


Ecology Wells Analyzed for Suprabasalt Sediments

Predominant Texture
- fine (silt & clay)
- fine/medium
- medium sand
- medium/coarse
- coarse (gravel)
- undetermined ("soil")

Dot in symbol indicates saturation within suprabasalt sediments

Unconsolidated Thickness (ft)
- <10
- 10 to 20
- >20 to 35
- >35 to 50
- >50 to 80
- >80

Other Ecology wells (not analyzed)

USGS well (not analyzed)

Study Area

WDNR 100K Geology

Geologic Units
- Basalt flows (Mc(e), Mv, PLMc(r))
- Pleistocene outburst flood deposits (Qfg, Qfs)
- Quaternary loess (Ql)
- Quaternary alluvium (Qa, Qaf, Qd)
- Quaternary mass-wasting deposits (Qls)
- Water

Structure
- Faults
- Anticline*
- Syncline*
- Monocline, anticlinal bend*

* dashed where concelaled

0 2 4 Miles

N

Figure 3-2

Horse Heaven Hills: Surficial Geology

Franklin Conservation District
Retiming Benefits Analysis

PgG

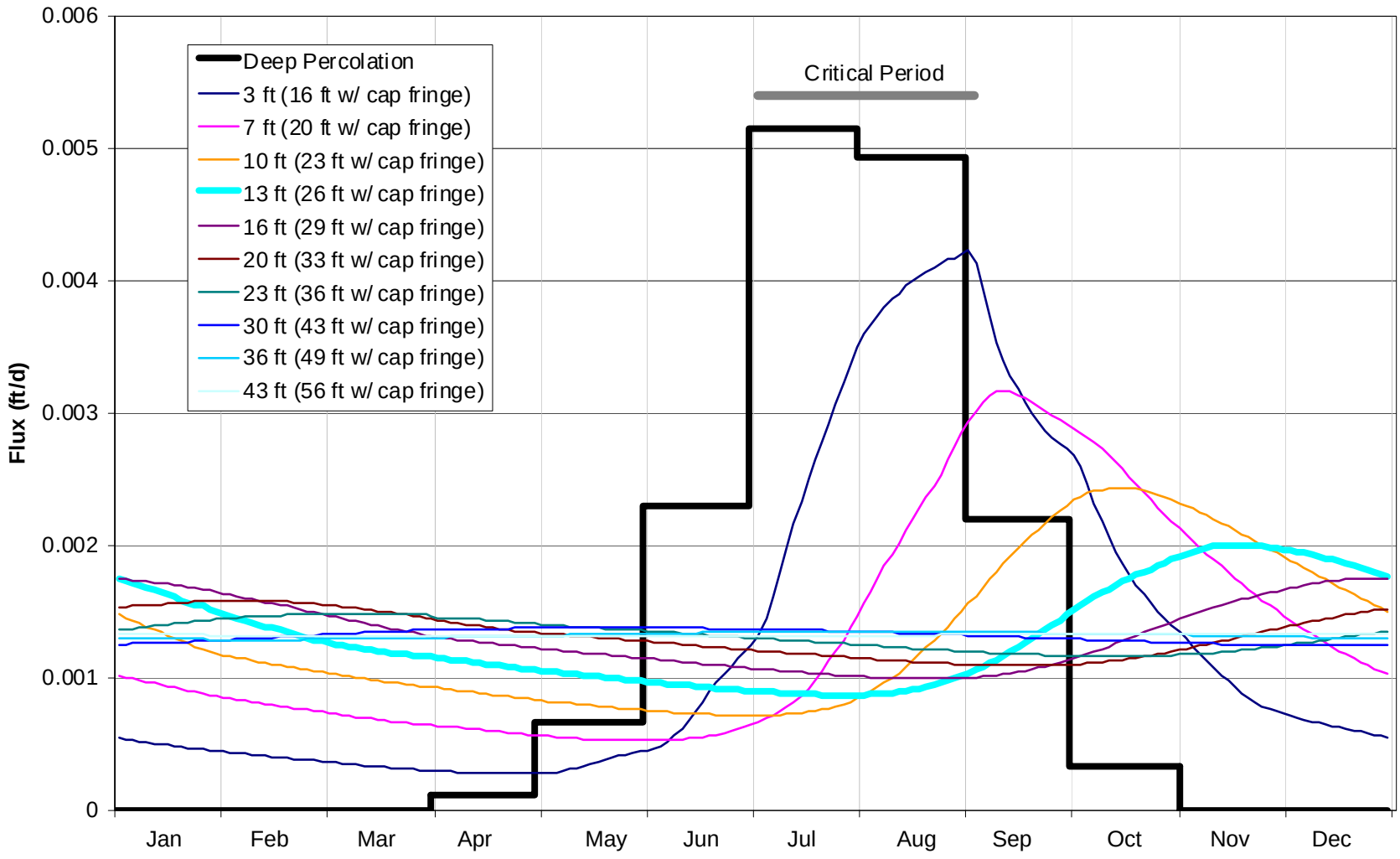


Figure 3-3
Horse Heaven Hills: "Central Value" Vadose Zone Flux Predictions for Loess Soil

Franklin Conservation District
Retiming Benefits Analysis

PgG

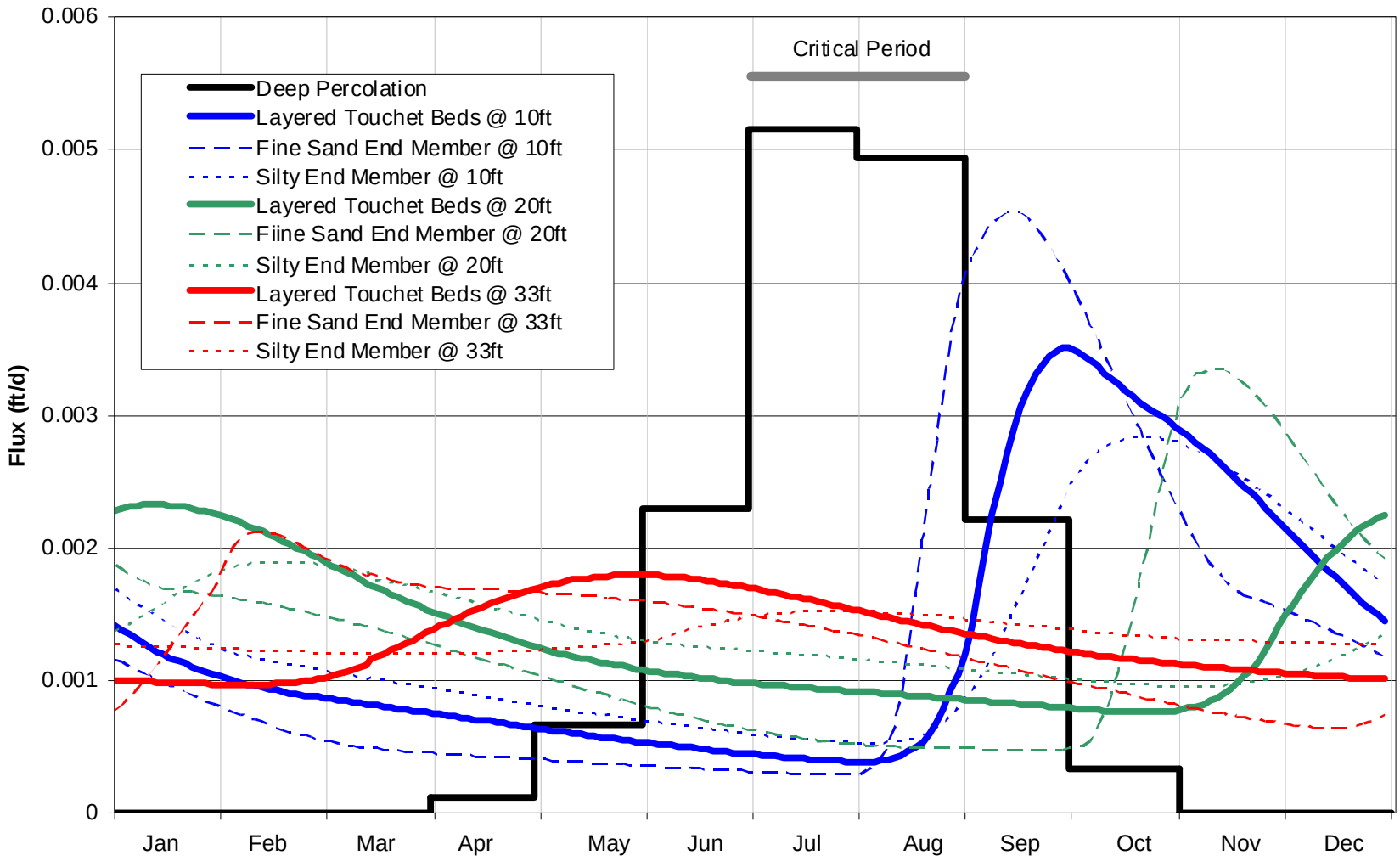


Figure 3-4
Horse Heaven Hills: Vadose Zone Flux Predictions for Touchet Beds

Franklin Conservation District
Retiming Benefits Analysis

PgG

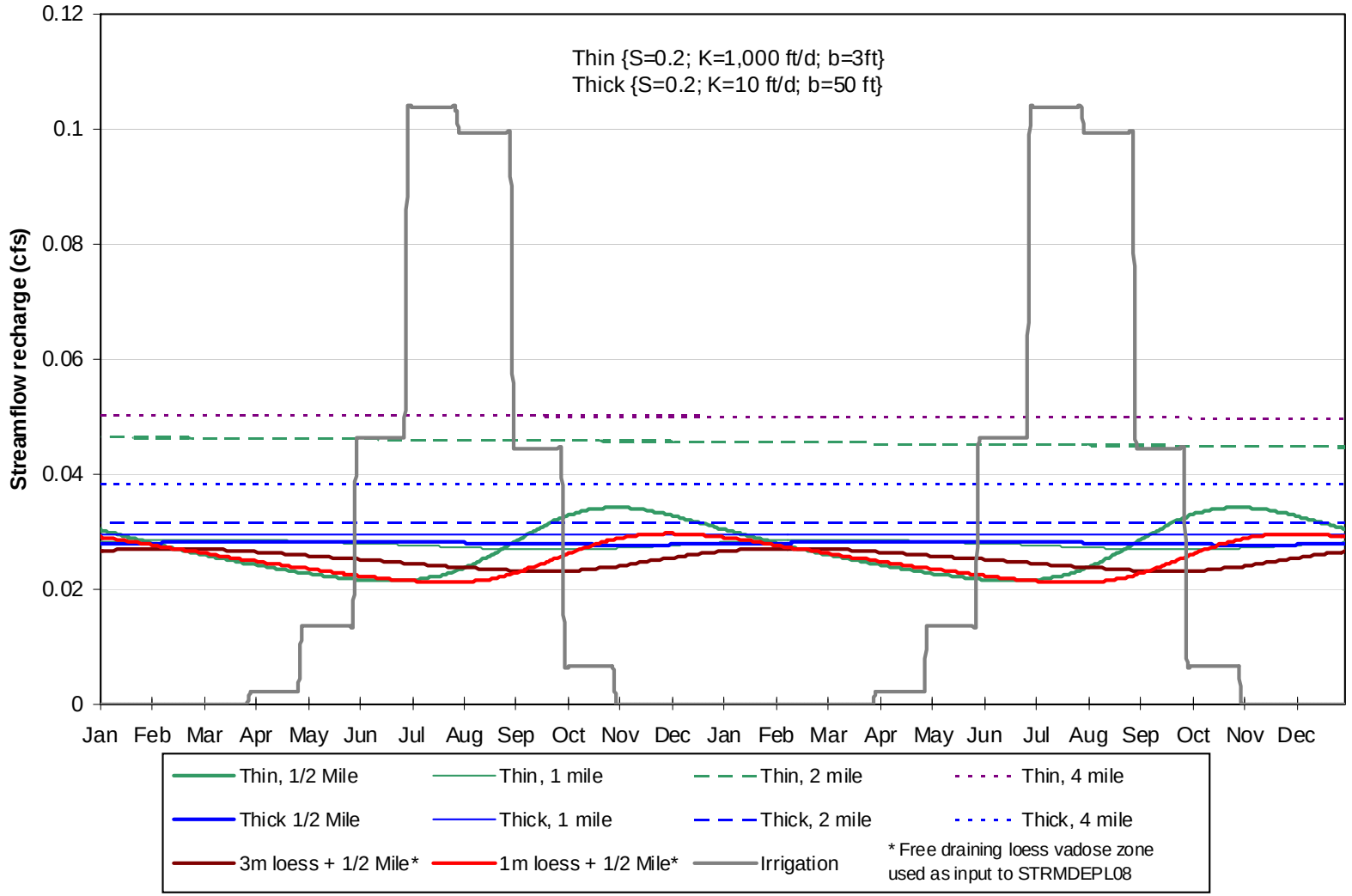


Figure 3-5
Horse Heaven Hills: STRMDEPL08 Model Predictions

Franklin Conservation District
Retiming Benefits Analysis

PgG

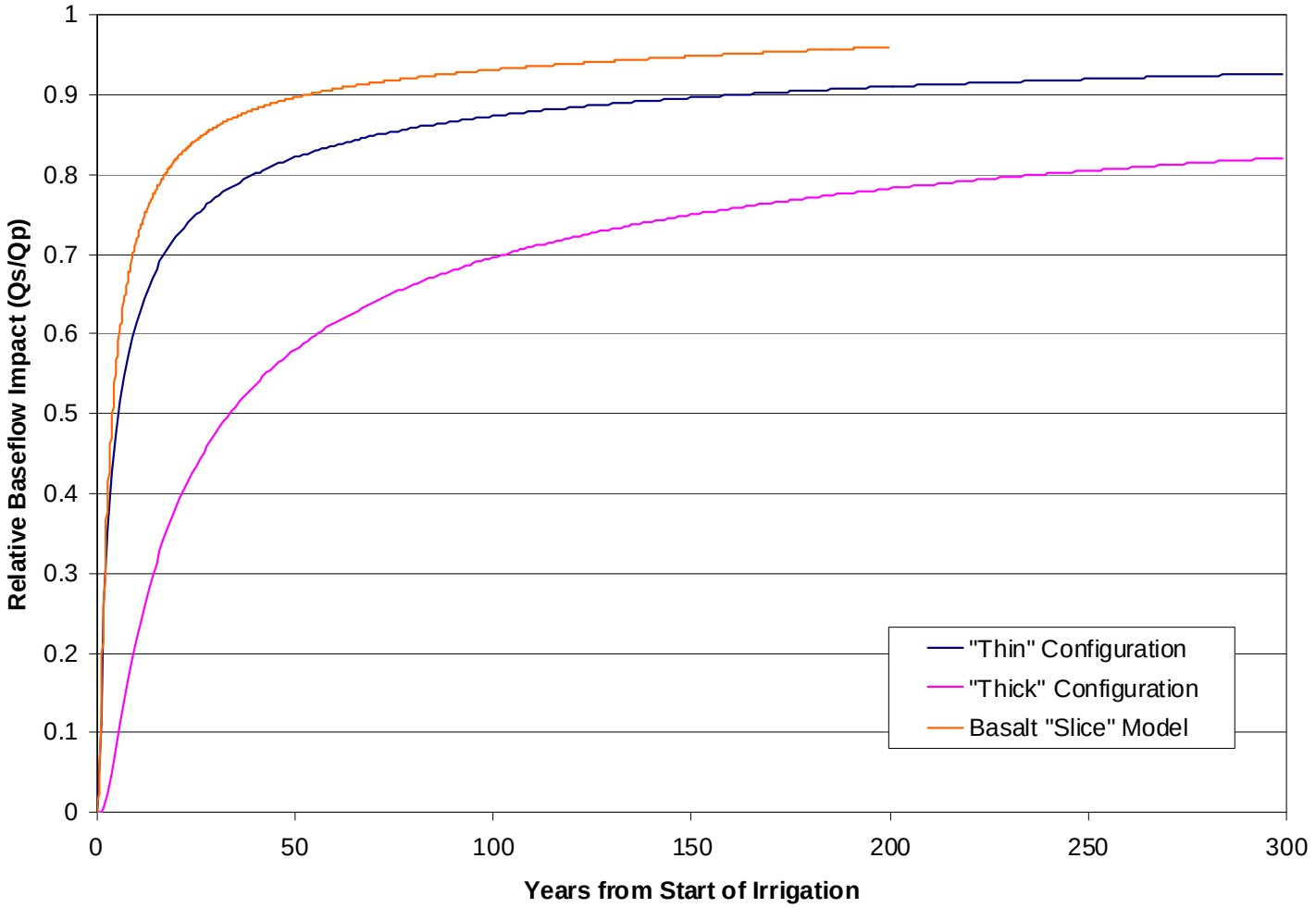


Figure 3-6
Horse Heaven Hills: Jenkins Model Streamflow Impacts Since Initiation of Recharge

Franklin Conservation District
Retiming Benefits Analysis

PgG

Franklin Conservation District
Retiming Benefits Analysis

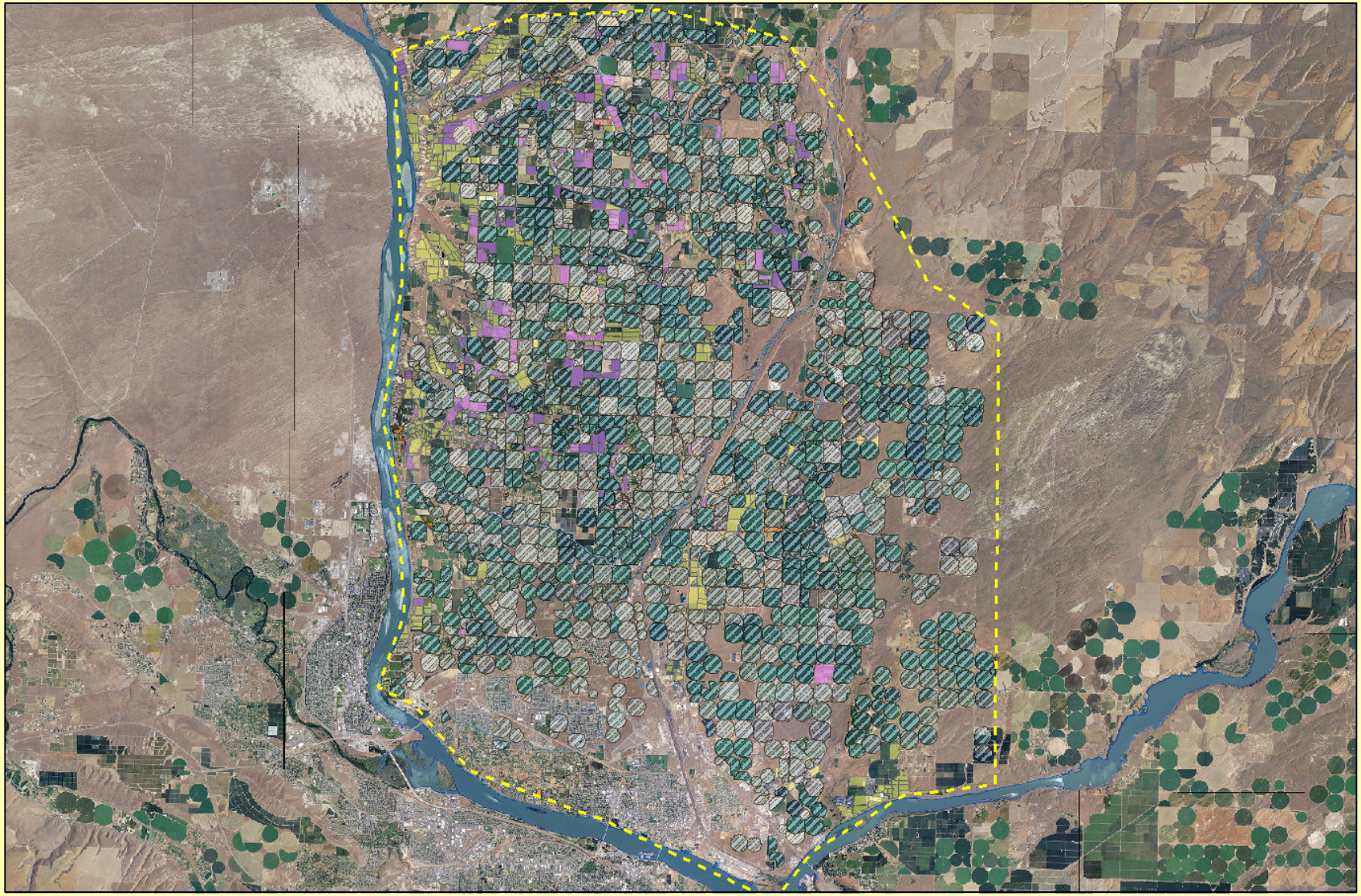
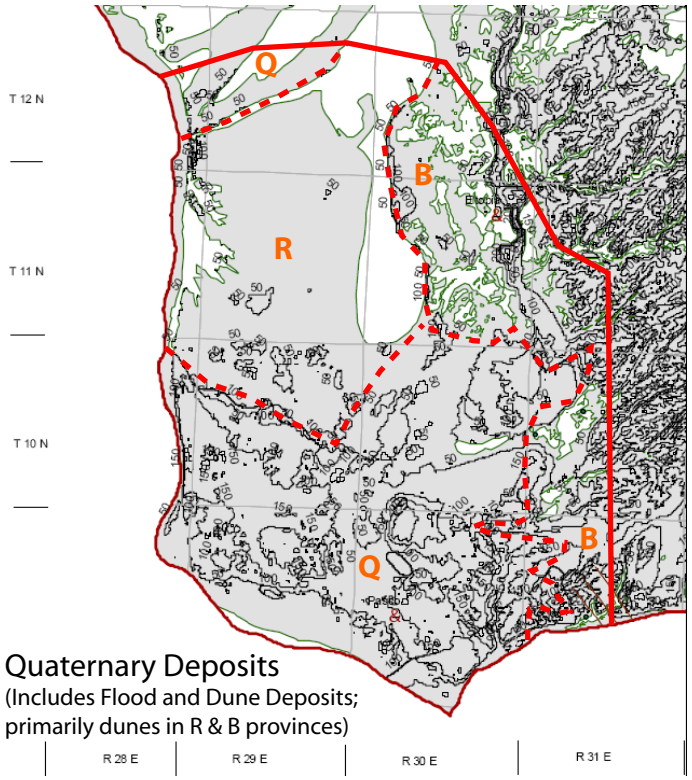
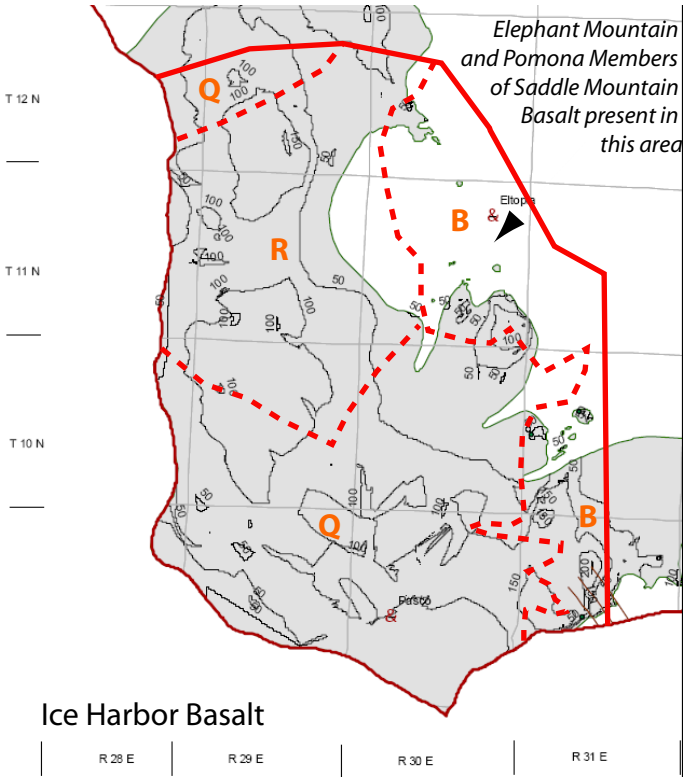


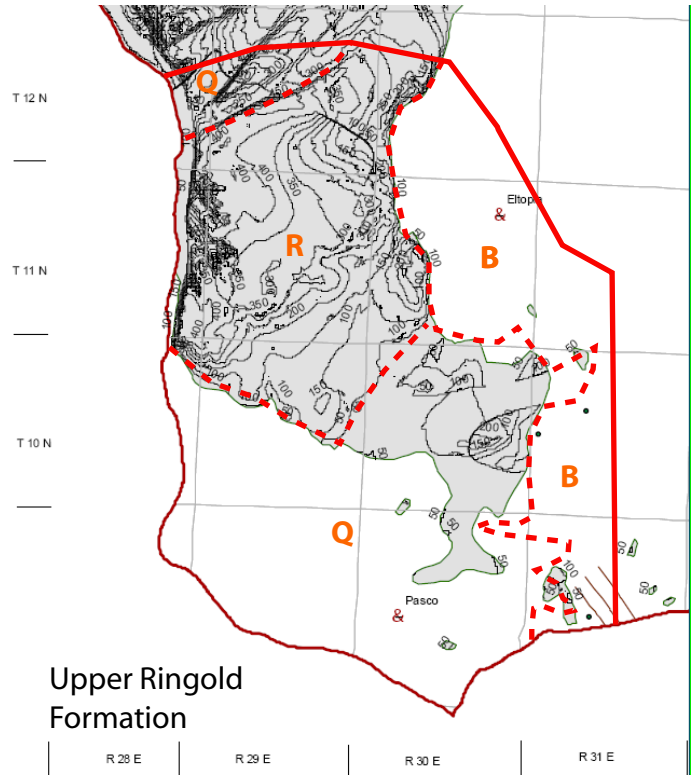
Figure 4-1
Irrigated Acreage in the Southern Franklin County Study Area



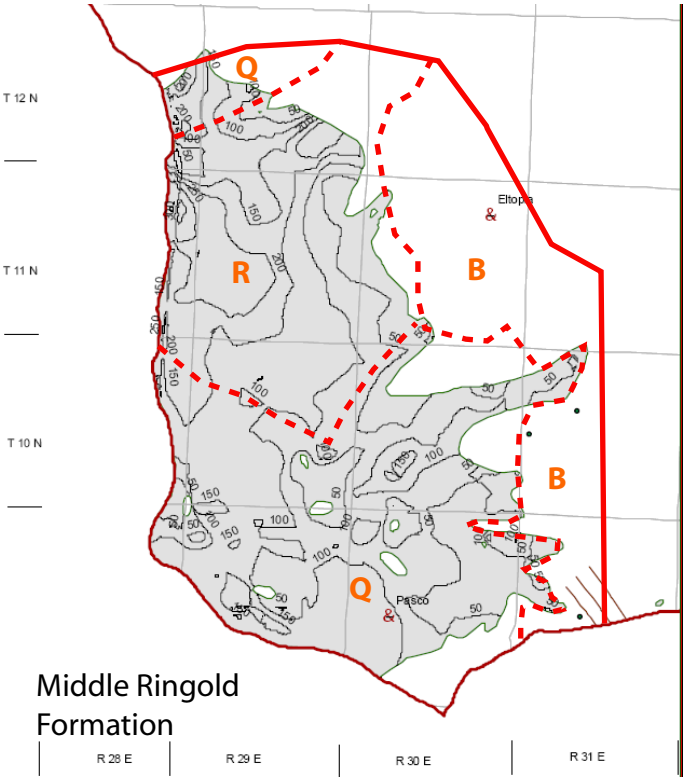
Quaternary Deposits
(Includes Flood and Dune Deposits; primarily dunes in R & B provinces)



Ice Harbor Basalt



Upper Ringold Formation



Middle Ringold Formation

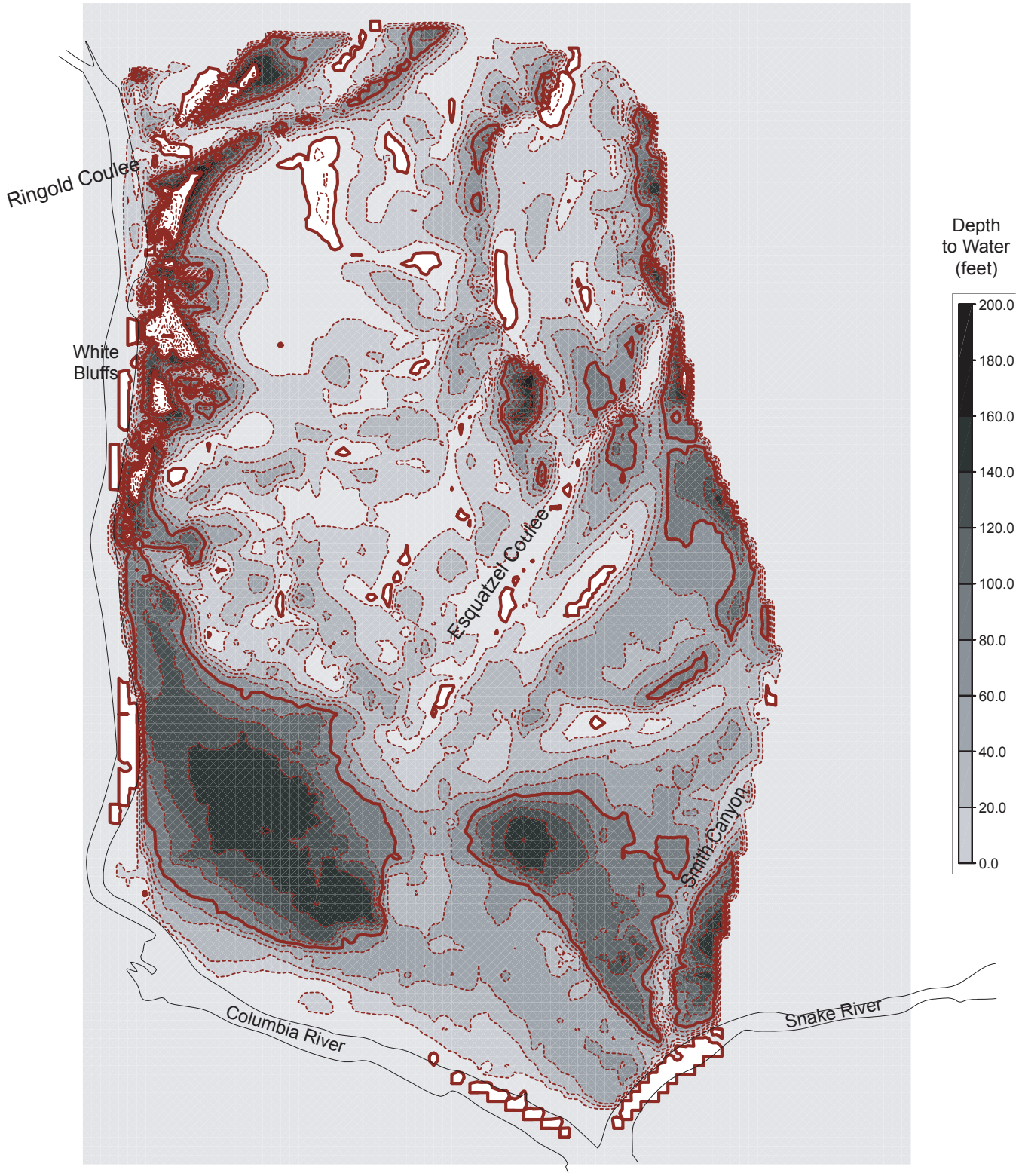
Modified from GWMA (2009) Plates 6, 12, 14, and 20.
Contour maps show 50 foot thickness intervals.

- Edge of Study Area
- Hydrogeologic Province Boundary: B=Basalt; R=Upper Ringold; Q=Quaternary

Figure 4-2
SFC: Extent and Thickness of Selected Units

Franklin Conservation District
Retiming Benefit Analysis

PgG



Depth to Water Contours.
Calculated by subtracting Drost 1986 water level map from surface elevations.

Note: white shading indicates out-of-range value where the Drost water table map projects above the DEM land surface. These artifacts are most common where the DTW is shallow, or where topography is steep or complicated.

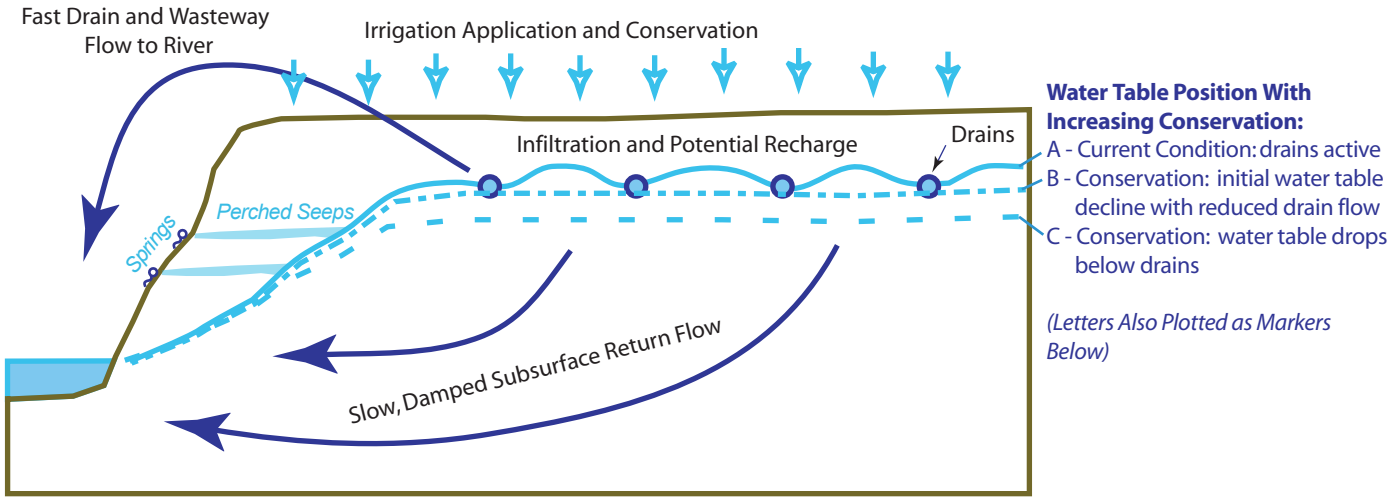
Figure 4-3
SFC: Depth to Water in Suprabasalt Aquifers

Franklin Conservation District
Retiming Benefit Analysis

PgG

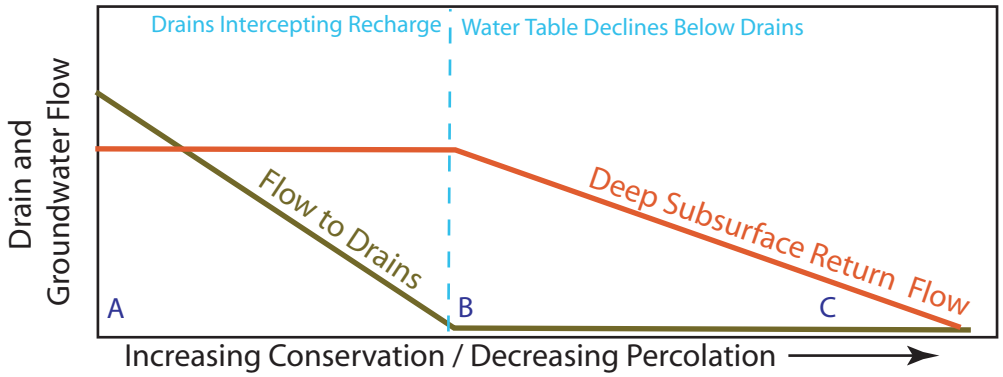
(a)

Schematic East-West Cross Section Through Upper Ringold Province

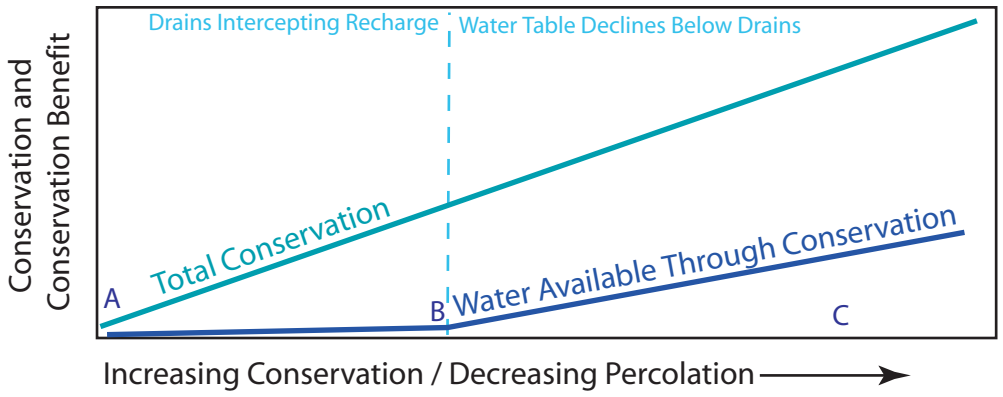


Conceptual Progression of Conservation Response

(b)



(c)



Conservation will primarily reduce flow to drains (A to B) until the water table drops below the drains (B) after which additional conservation will primarily reduce subsurface return flow (B to C). Reduction of drain flow does not produce significant retiming benefit. Benefit would be derived from reduction in deep subsurface return flow.

Figure 4-4
SFC: Conceptual Relationship Between Drains and Conservation Benefit

Franklin Conservation District
Retiming Benefit Analysis

PgG

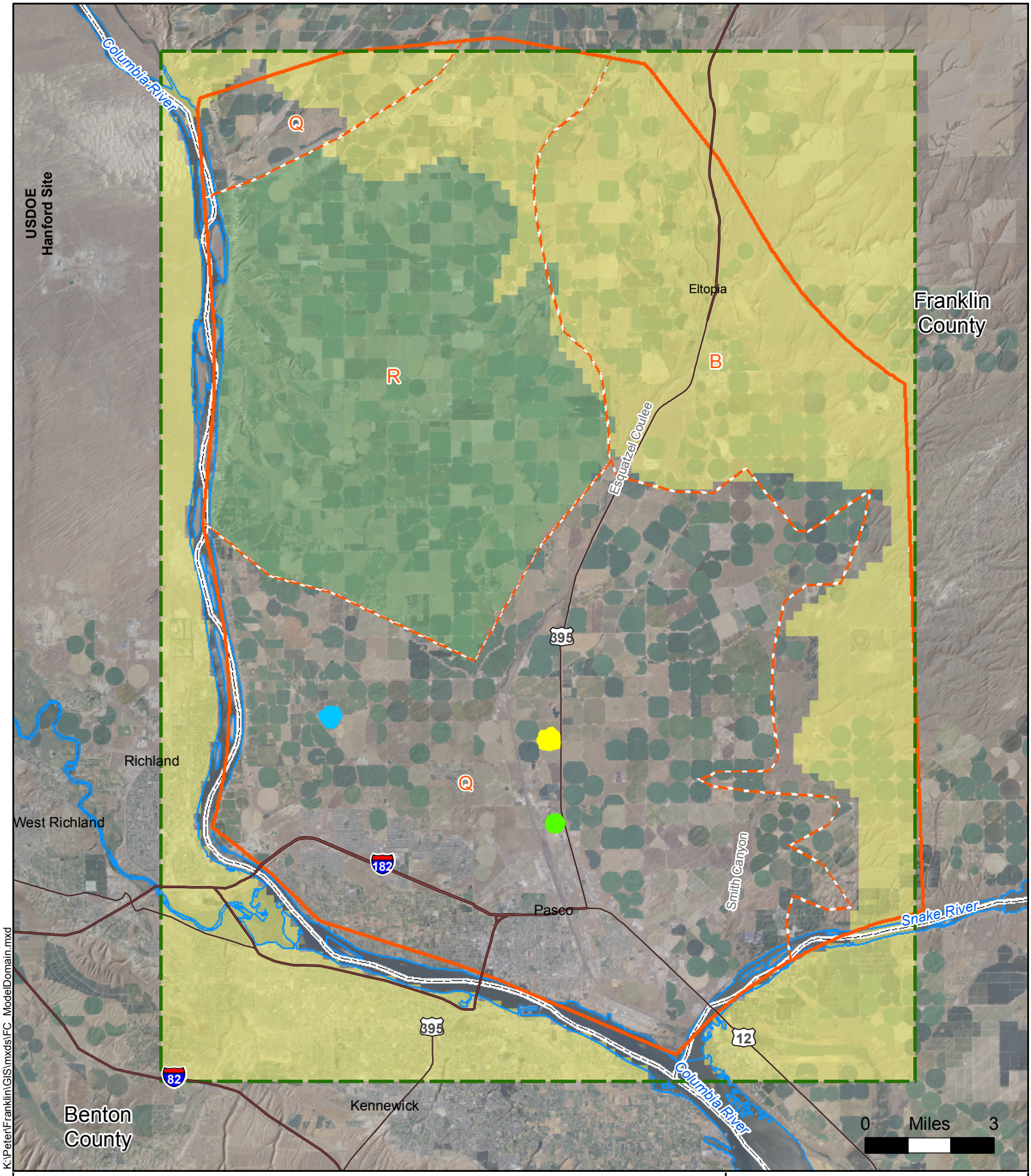


Figure 4-5
SFC: Model Domain and Hypothetical Conservation Sites

Franklin Conservation District
Retiming Benefits Analysis

PgG

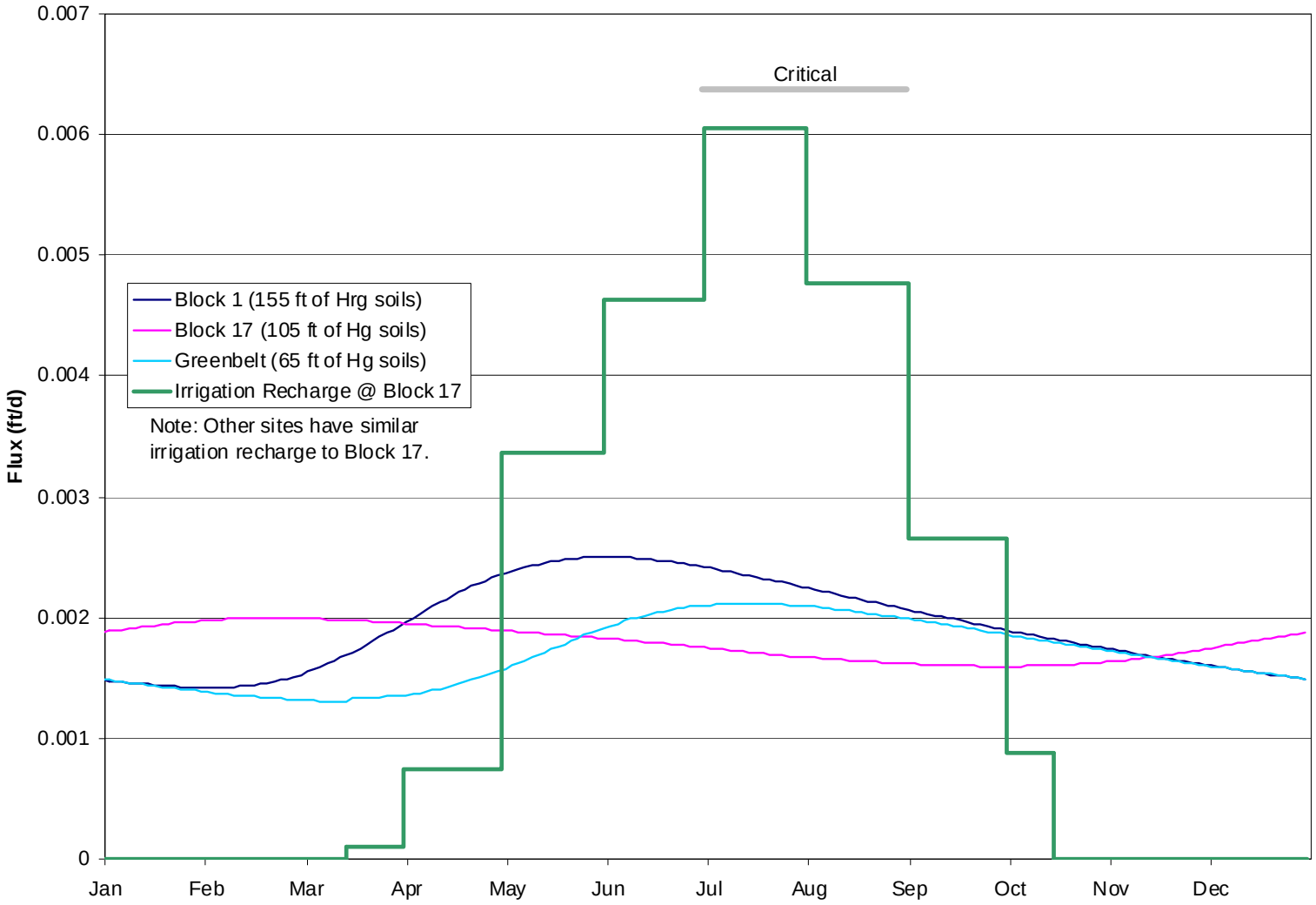


Figure 4-6
SFC: Pre-Conservation Hydrus Results for 3 Hypothetical Conservation Sites

Franklin Conservation District
Retiming Benefits Analysis

PgG

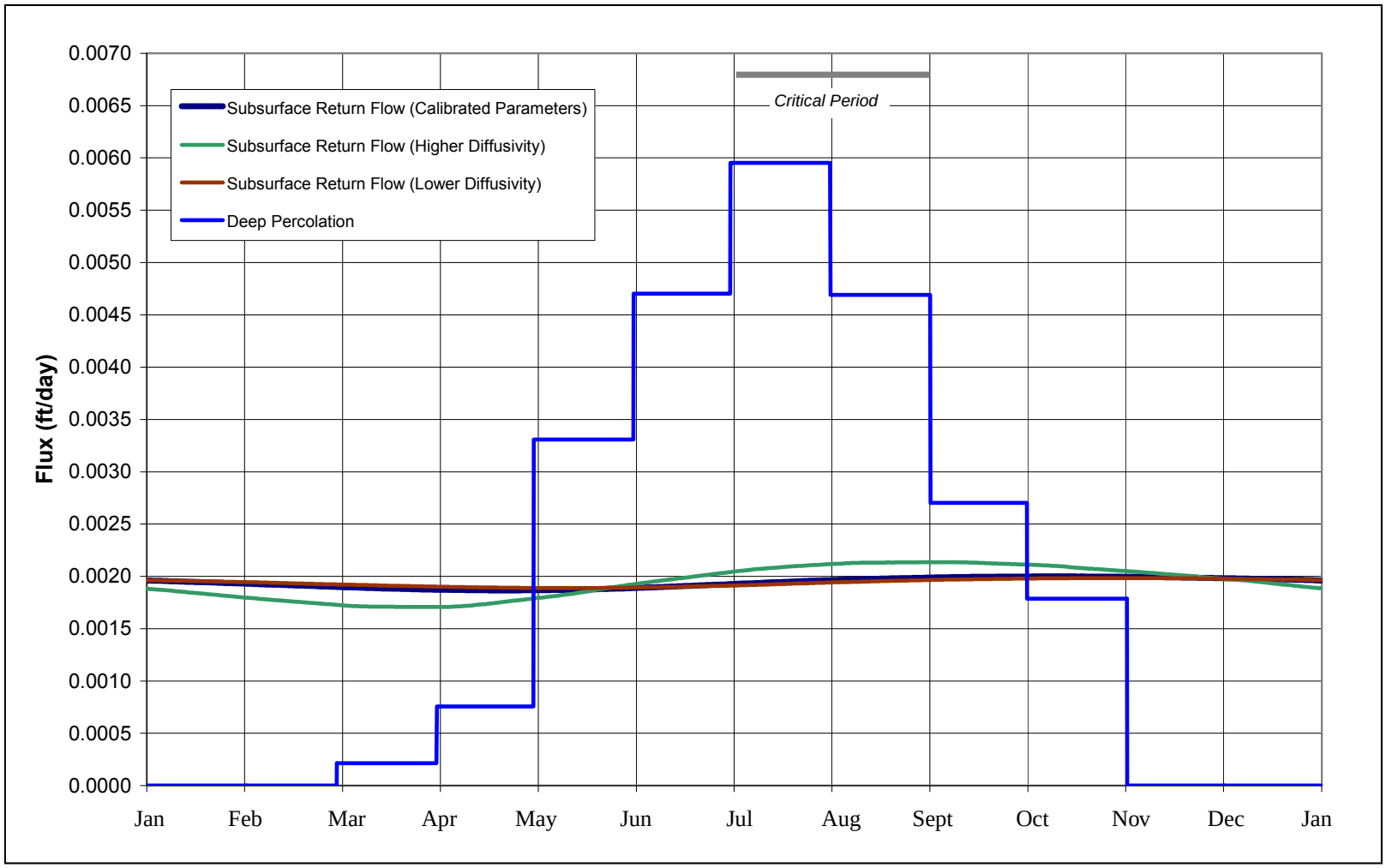


Figure 4-7
SFC: Predicted Subsurface Return Flow at Block 1 Site

Franklin Conservation District
Retiming Benefits Analysis

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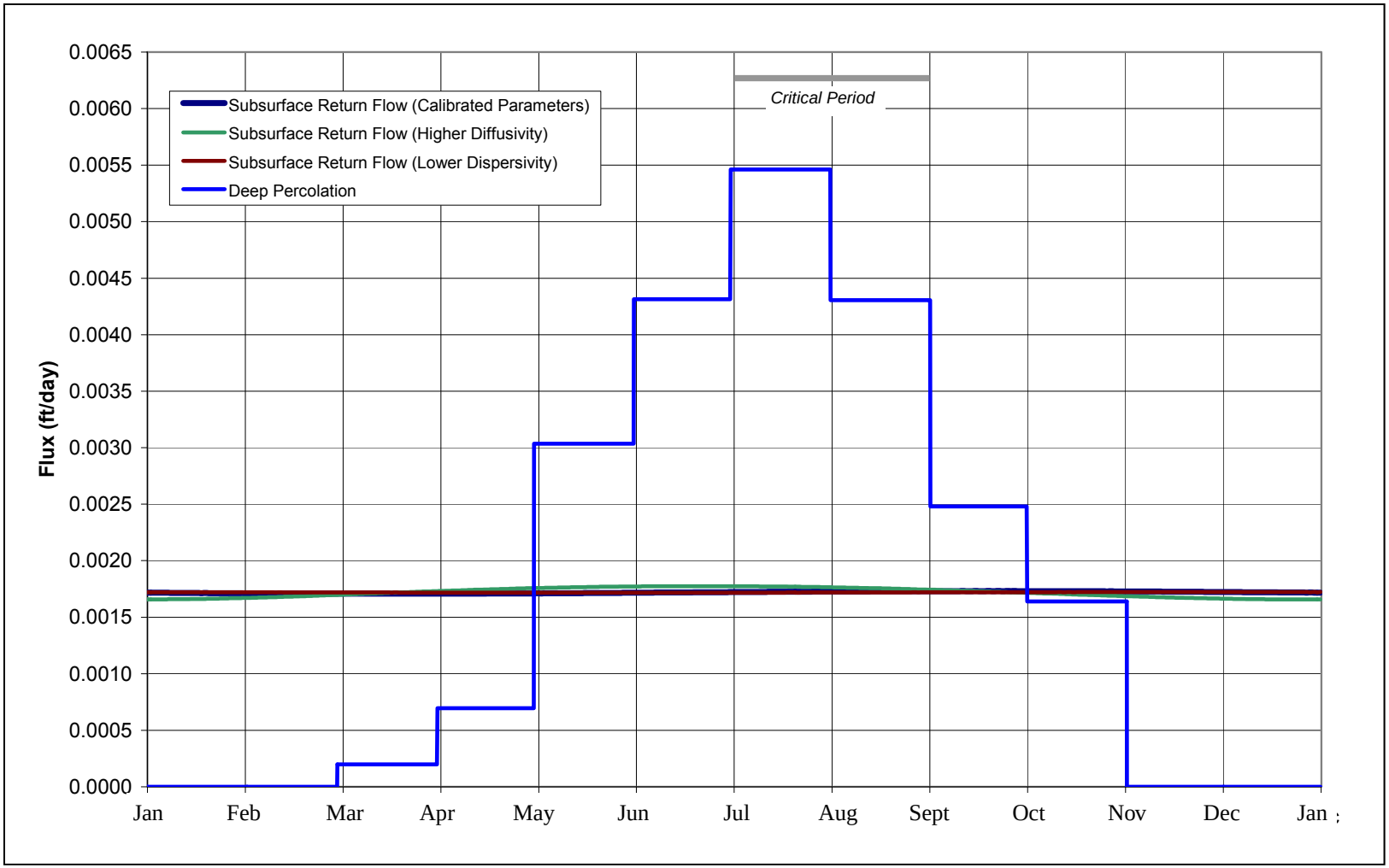

Figure 4-8
SFC: Predicted Subsurface Return Flow at Block 17 Site

Franklin Conservation District
Retiming Benefits Analysis

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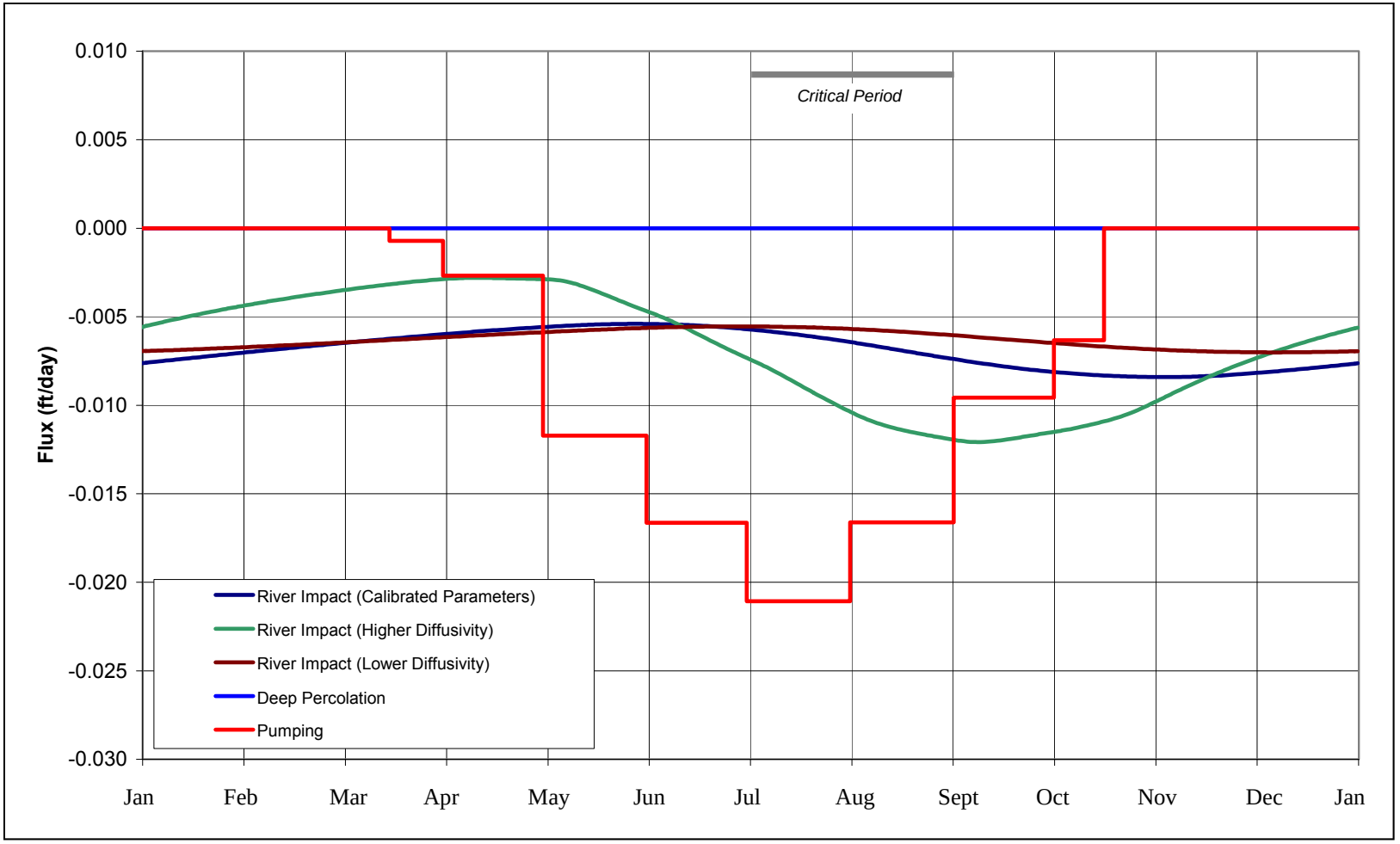

Figure 4-9
SFC: Predicted Post-Conservation Net River Impact (I_N) at Greenbelt Site

Franklin Conservation District
Retiming Benefits Analysis

PgG

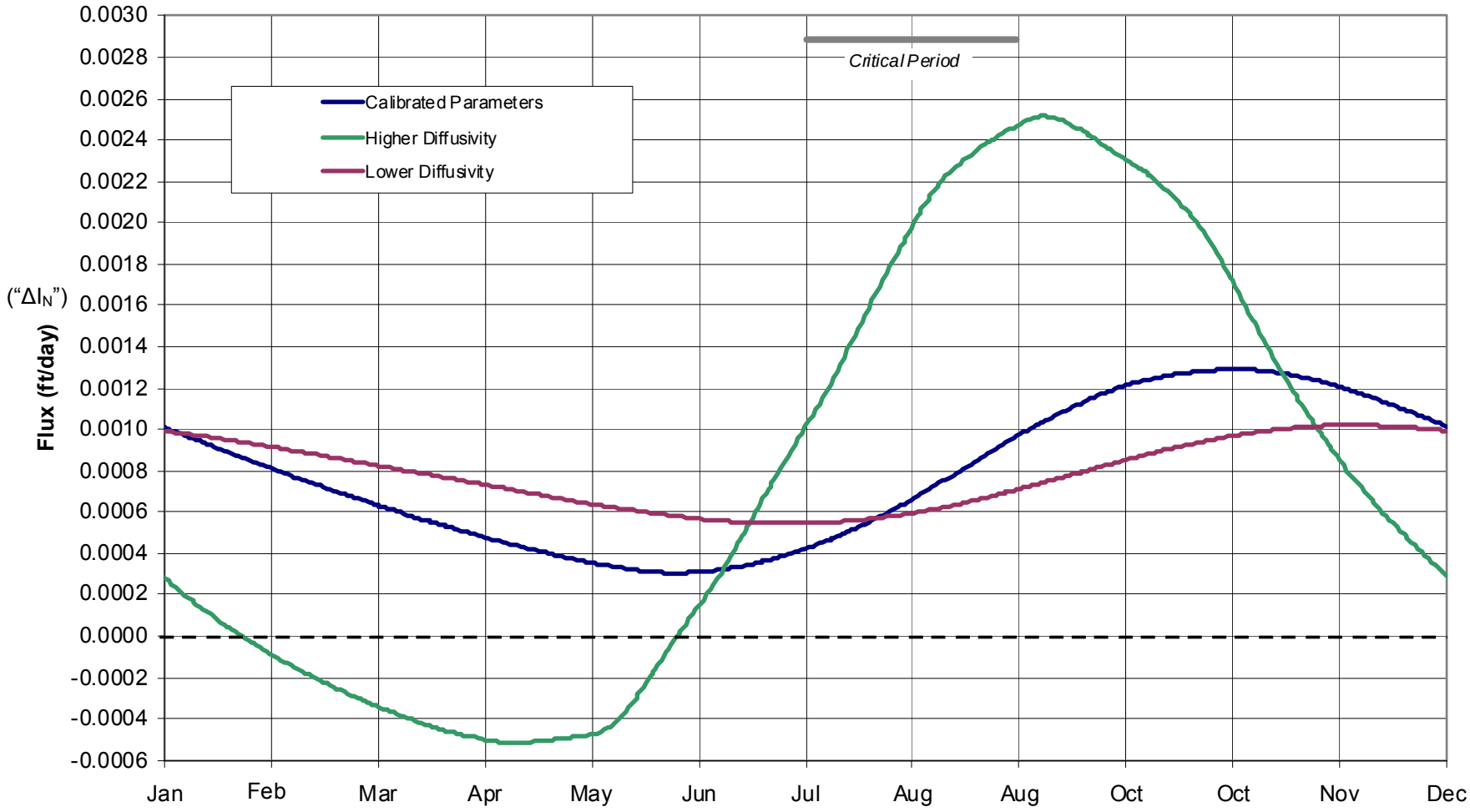

Figure 4-10
SFC: Estimated Conservation Benefit (ΔI_N) at Greenbelt Site

Franklin Conservation District
Retiming Benefits Analysis

PgG

Franklin Conservation District
Retiming Benefits Analysis

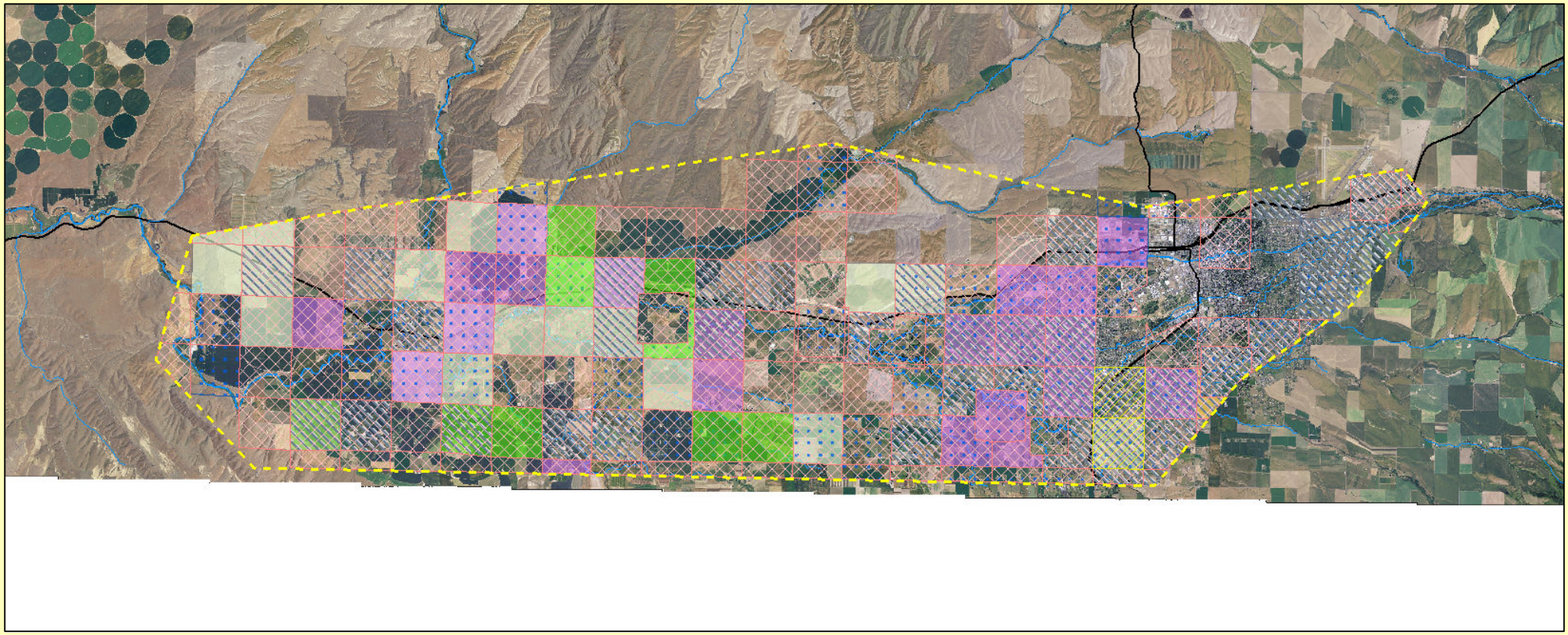

Figure 5-1
Irrigated Acreage in the Walla Walla Study Area

1 INCH = 10,000 FEET

10,000 Feet

DRAWING IS NOT TO SCALE
IF BAR IS NOT 1" LONG

REV DATE: OCT 14, 2010

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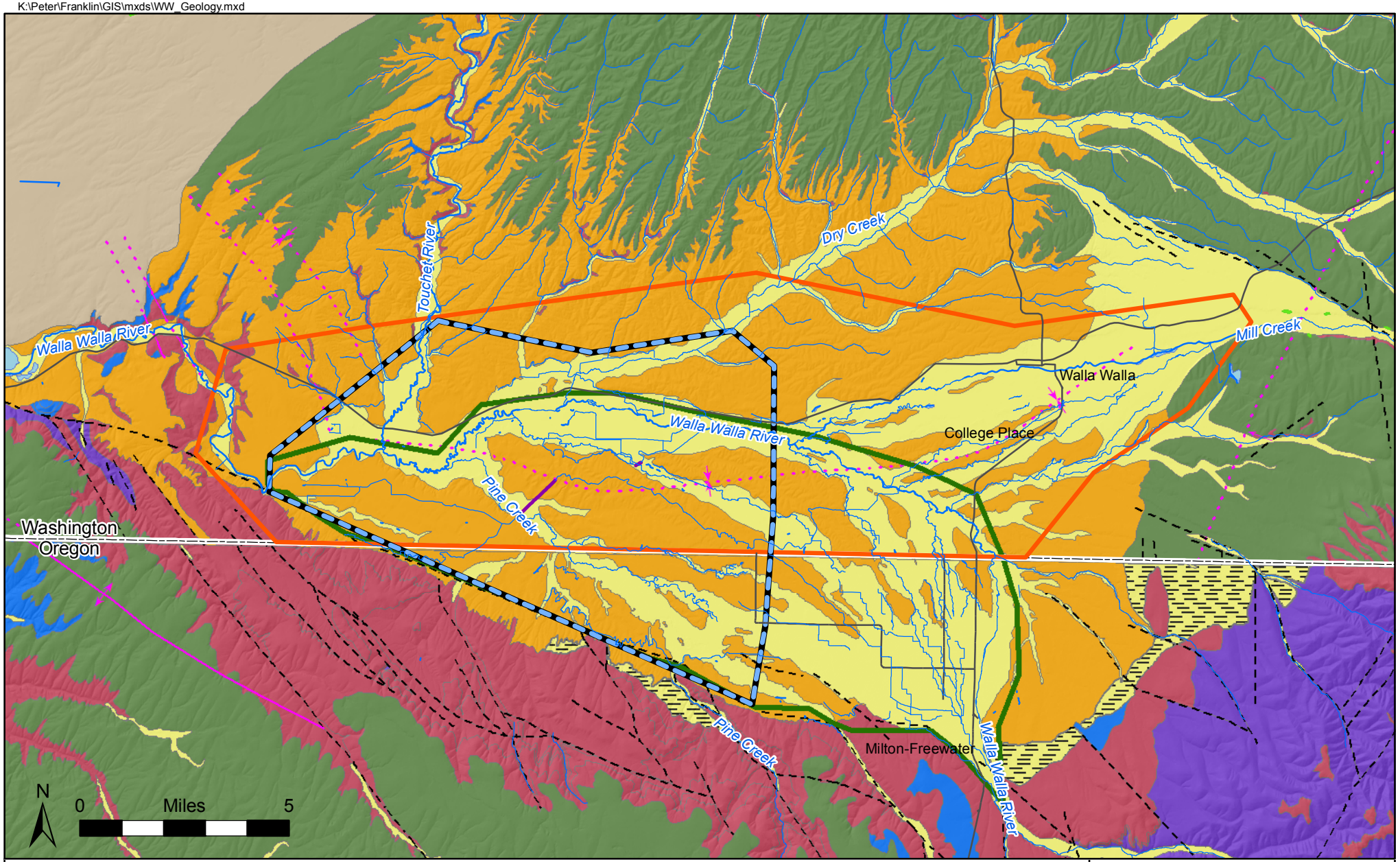

Walla Walla Study Area
PGG Model Domain
Petrides Model Domain

Geologic Units (from WA DNR and OR DOGAMI)

Unconsolidated
- Alluvial deposits
- Alluvial fan gravel of Milton-Freewater
- Dune sand
- Loess
- Outburst flood deposits, sand and silt
- Sedimentary deposits, Ringold

Basalt
- Saddle Mountain Basalt
- Wanapum Basalt
- Grande Ronde Basalt

Faults

Folds (Dashed where concealed)
- Anticline
- Syncline
- Monocline, synclinal bend

Figure 5-2

Walla Walla: Surficial Geology

Franklin Conservation District
Retiming Benefits Analysis

PgG

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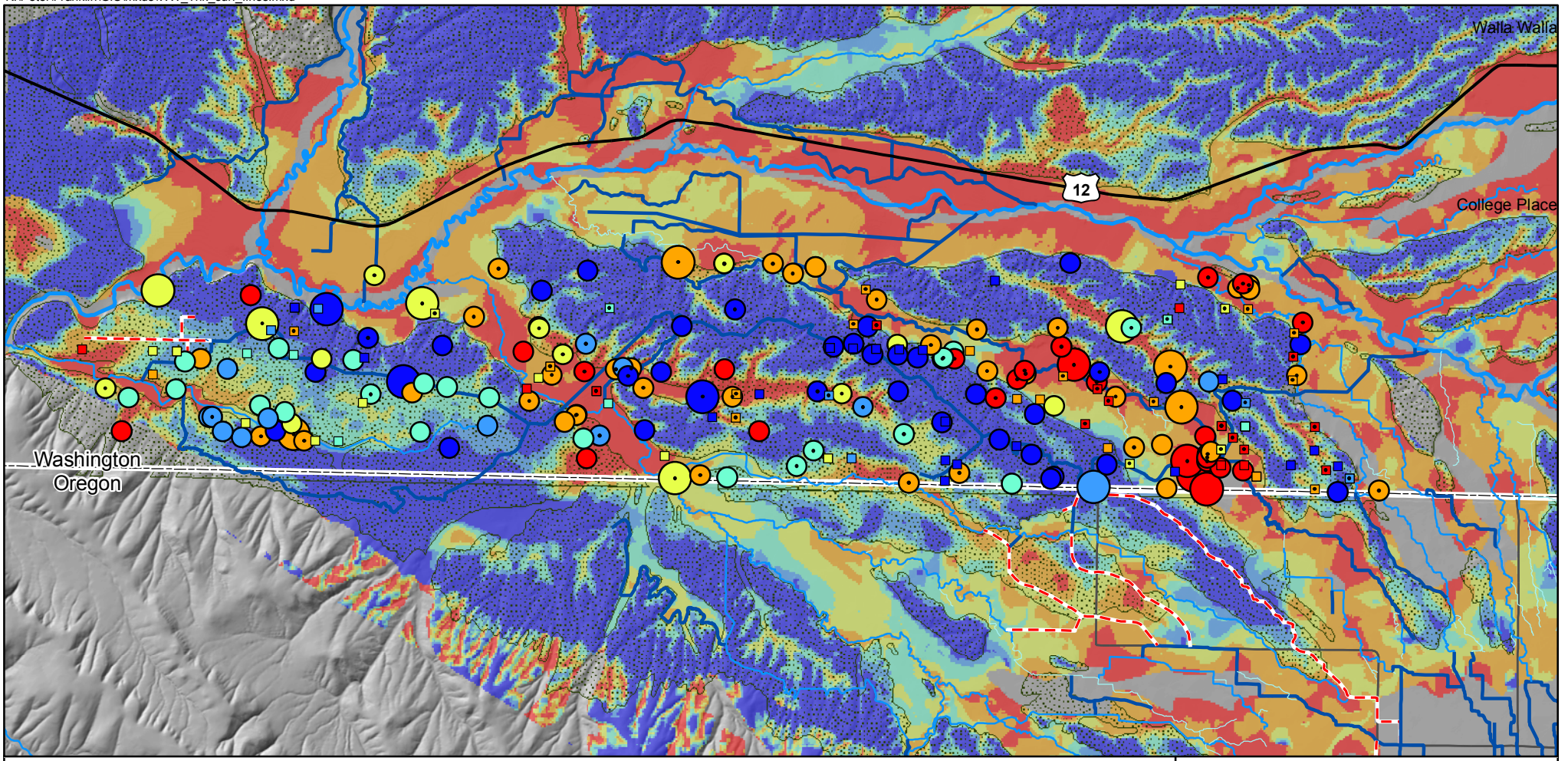

Depth to Bottom of Surficial Fines

Observed in Wells Logs located by:

WWBWC	PGG	QQ Section	
			0 - 10 ft
			10.1 - 20 ft
			20.1 - 30 ft
			30.1 - 40 ft
			40.1 - 50 ft
			> 50 ft

More Accurate Location ← → Less Accurate Location

• Depth to Water < 25 feet

Qf Thickness (GSI, 2007)

- 0 - 10 ft
- 10.1 - 20 ft
- 20.1 - 30 ft
- 30.1 - 40 ft
- 40.1 - 50 ft
- > 50 ft

N

0 Miles 2

Figure 5-3
Walla Walla: Thickness of Surficial Fine-Grained (Qf) Sediments Near Gardena Terrace

Franklin Conservation District
Retiming Benefits Analysis

PgG

NOTE: values following well log ID letters are rough estimates of groundwater level elevations in feet (NAVD88).

Figure 5-4
Wells in Vicinity of Proposed Gardena Terrace Pilot Site

Franklin Conservation District
Retiming Benefits Analysis

PgG

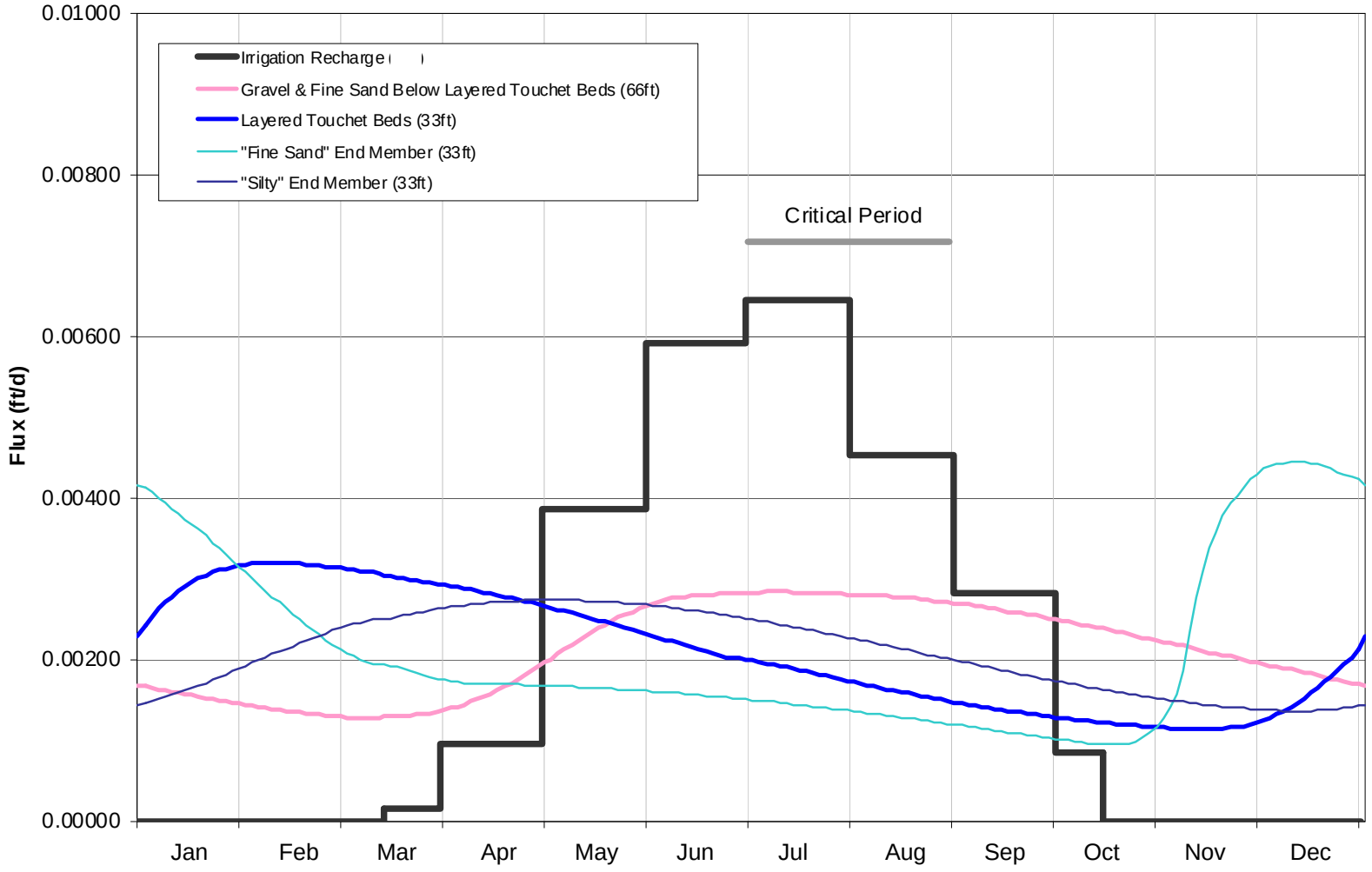

Figure 5-5
Walla Walla: Comparison of Hydrus Pre-Conservation Results for Various Vadose Zone Configurations

Franklin Conservation District
Retiming Benefits Analysis

PgG

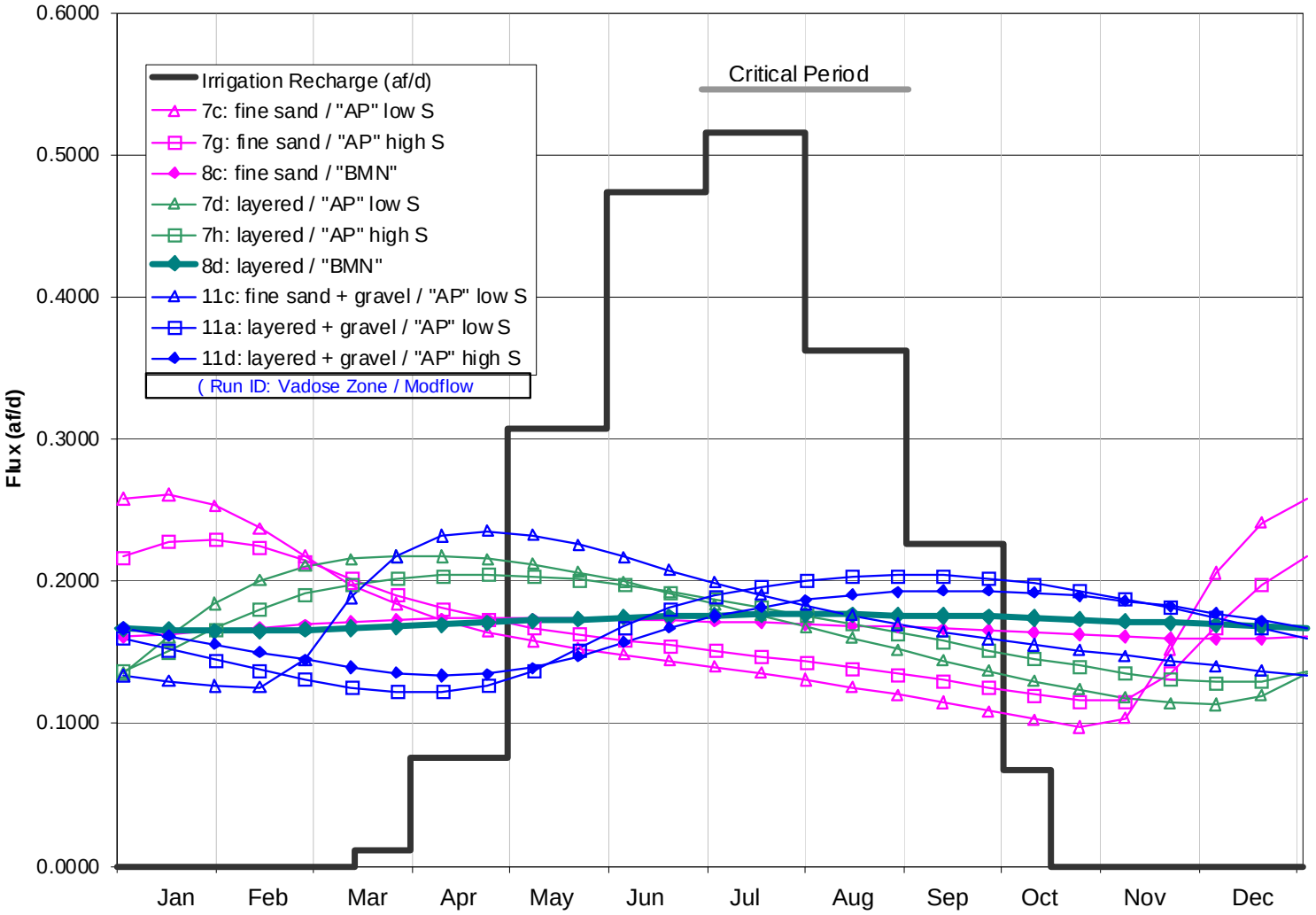

Figure 5-6
Walla Walla: Predicted Pre-Conservation Groundwater Discharge to Surface Water from Site Irrigation

Franklin Conservation District
Retiming Benefits Analysis

PgG