Alternate Methods for Automatic Selection of Primary Paths Through Braided Hydrographic Networks

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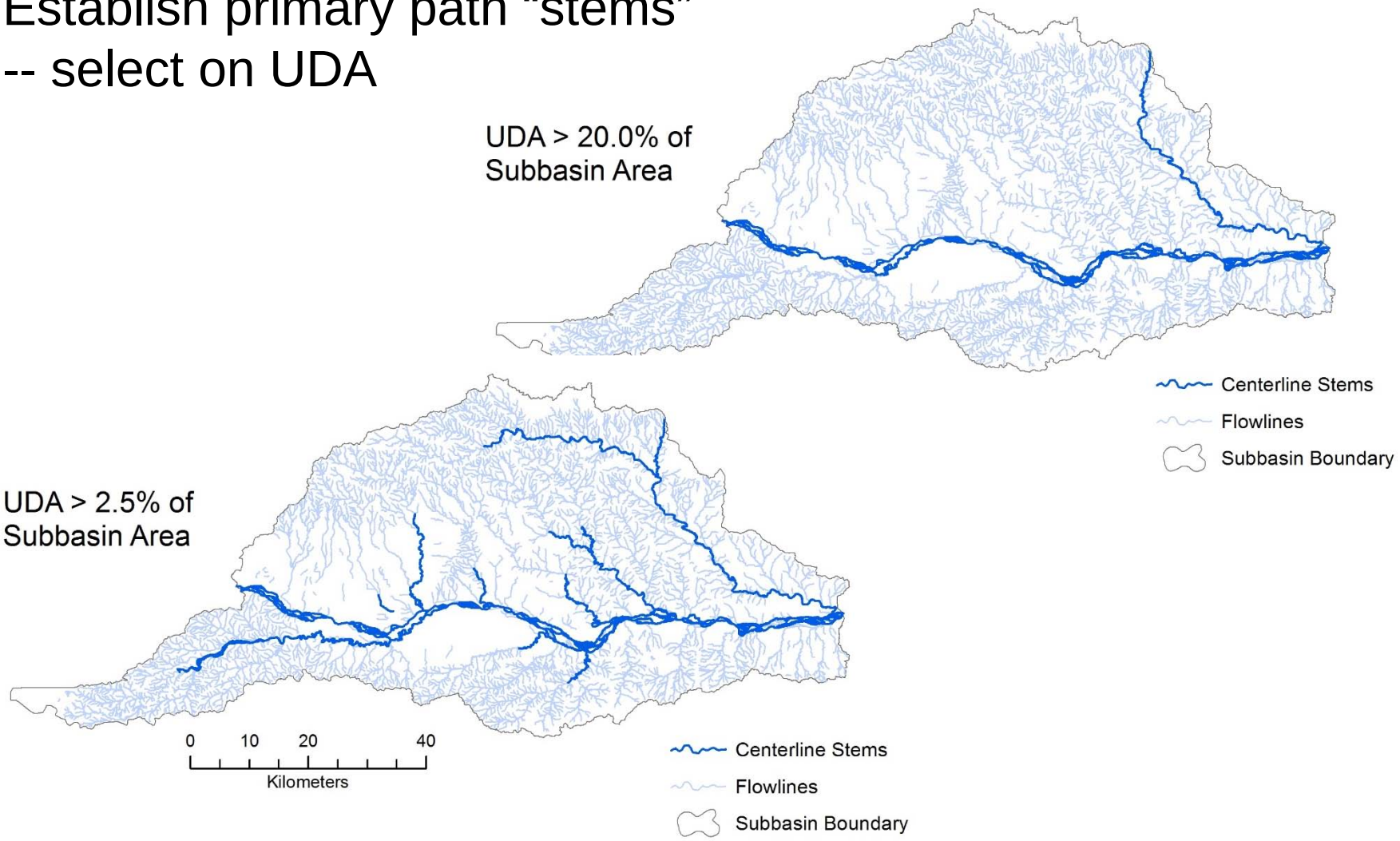
Why delineate primary paths?

- Primary channels contain the most water – useful for topographic base mapping and hydrological analysis
- Automatic methods often based on stream order.

- Automated methods difficult with High Resolution (24K) NHD (National Hydrography Dataset)
  - Stream order not explicitly coded, due to database size and irregular update cycle
  - Prioritize stream channels by Upstream Drainage Area (UDA)

Basic Delineation Algorithm – Stage 1

1. Establish primary path “stems”
   -- select on UDA



Basic Delineation

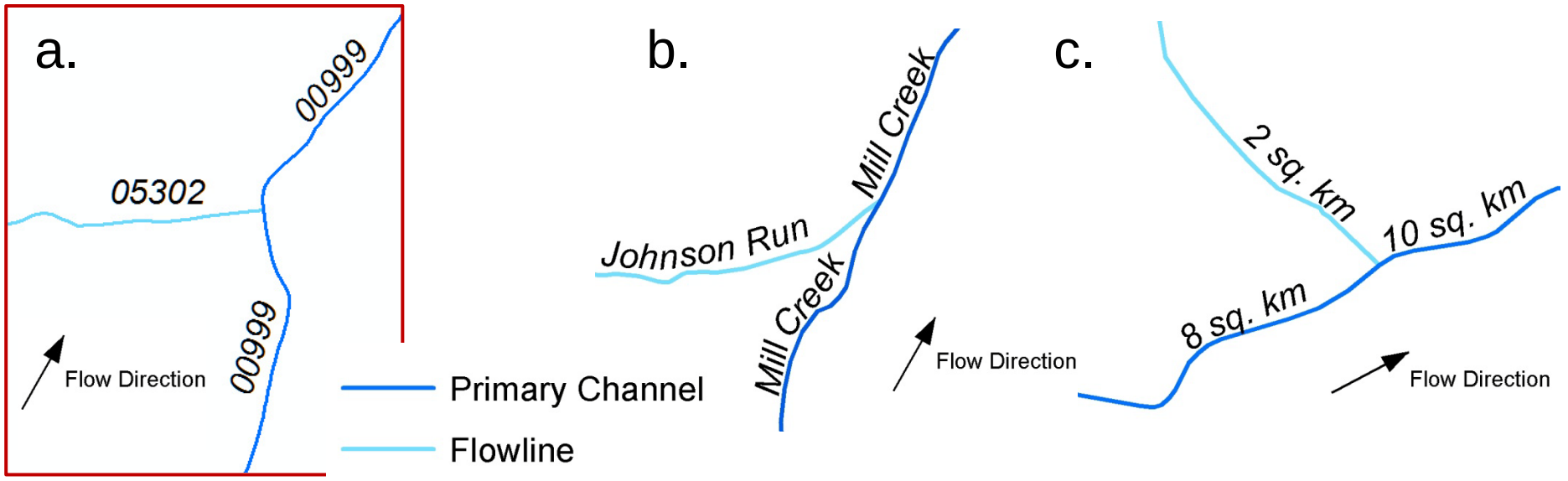
2. Trace path upstream from each "stem" to headwaters

At each confluence, select a primary channel as follows:

a. If one tributary shares Reachcode of downstream flowline, select it
ELSE

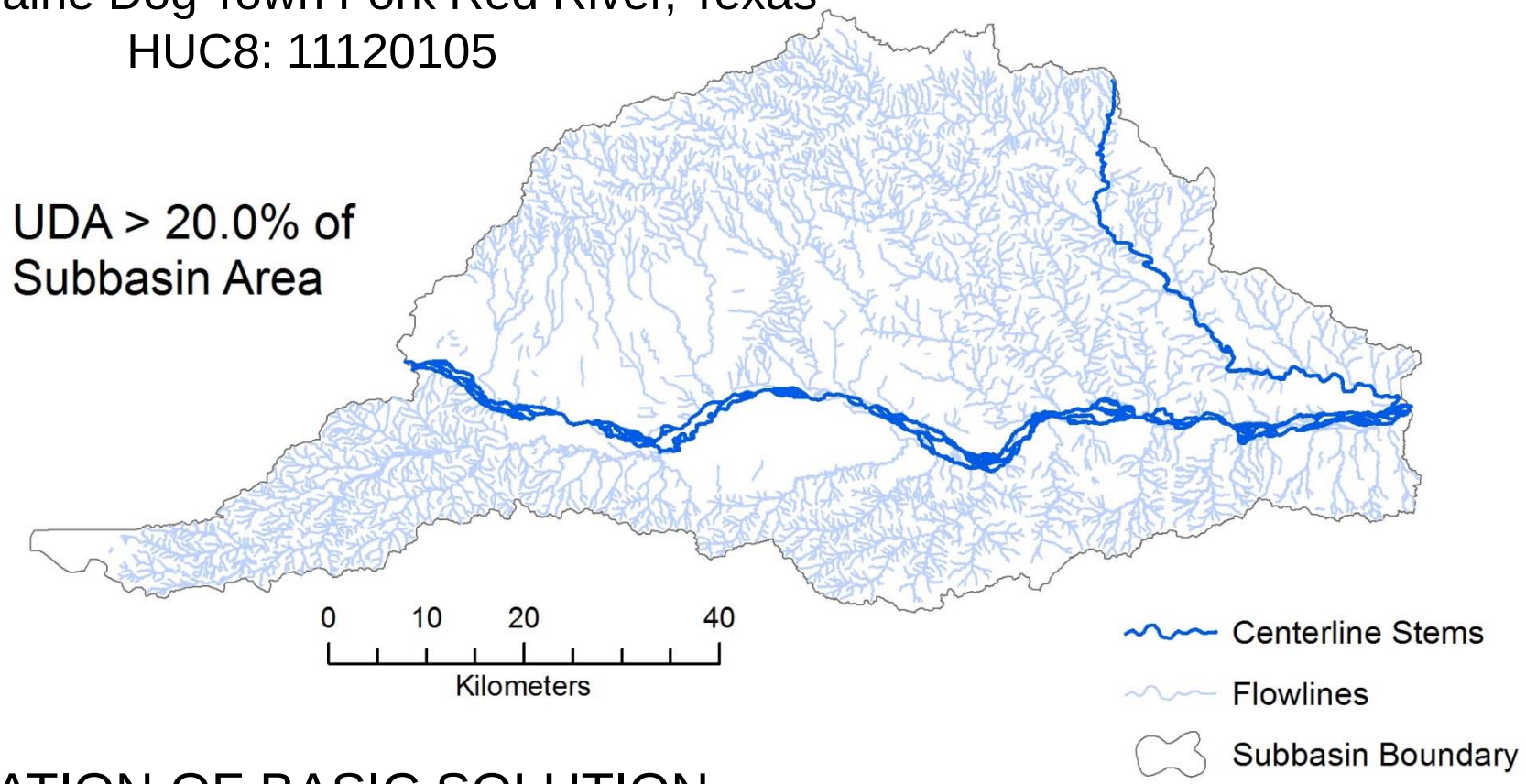
b. If one tributary shares GNIS Name of downstream flowline select it
ELSE

c. If neither/both tributaries share Reachcode/GNIS name … select the tributary with greater UDA value



Results of Basic Delineation – Stage 1

Lower Prairie Dog Town Fork Red River, Texas
HUC8: 11120105

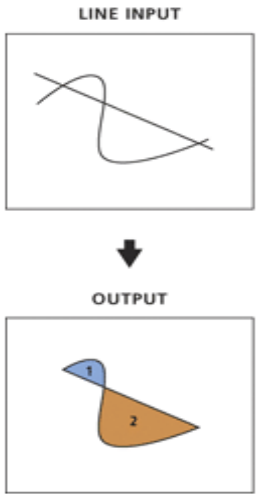


LIMITATION OF BASIC SOLUTION

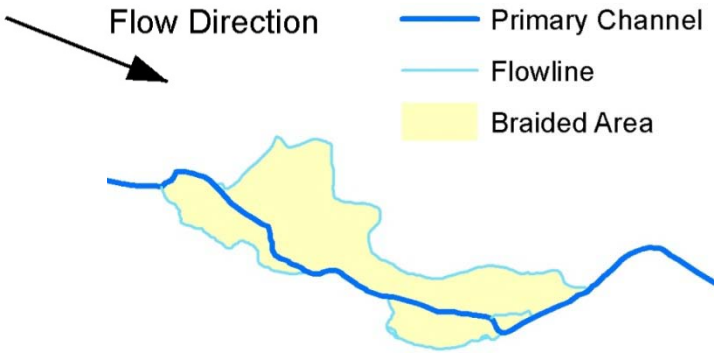
- Including all braided channels can produce overly complex primary path
- Following basic identification, delineate one or several paths through the braid to prioritize channels or to clarify map display

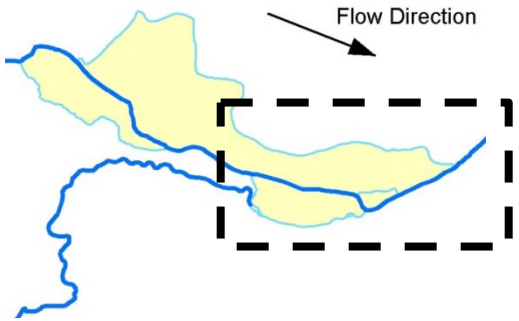
Solution 1: Inner Channel Algorithm

- Isolate a set of braided channels
  - Convert flowlines to polygons
  - Dissolve; select flowlines contained in braid polygons
- Work upstream from the outflow channel of each braid polygon
- Use the same basic delineation rules at confluences trace single primary path through braid
  1. Reachcode ID match
  2. GNIS Name match
  3. Highest UDA



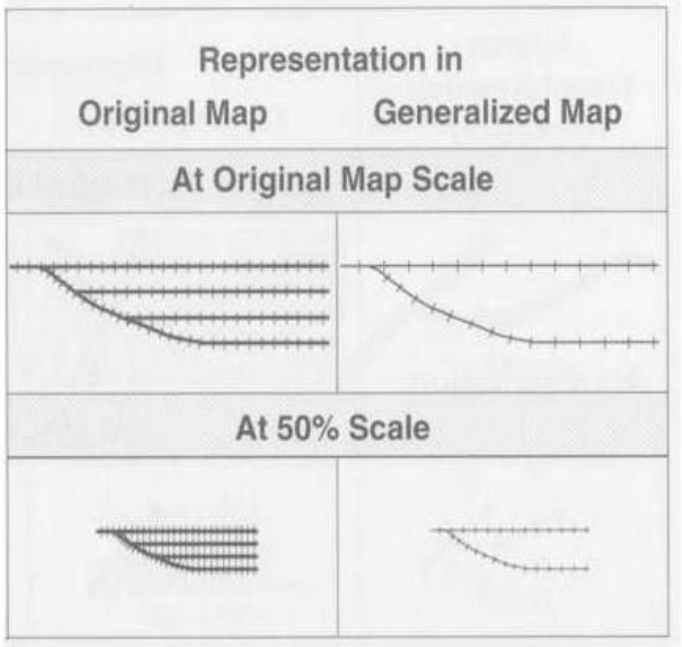
When multiple inflows contribute to a braid, isolate new braid polygon and delineate primary channel using same basic delineation rules





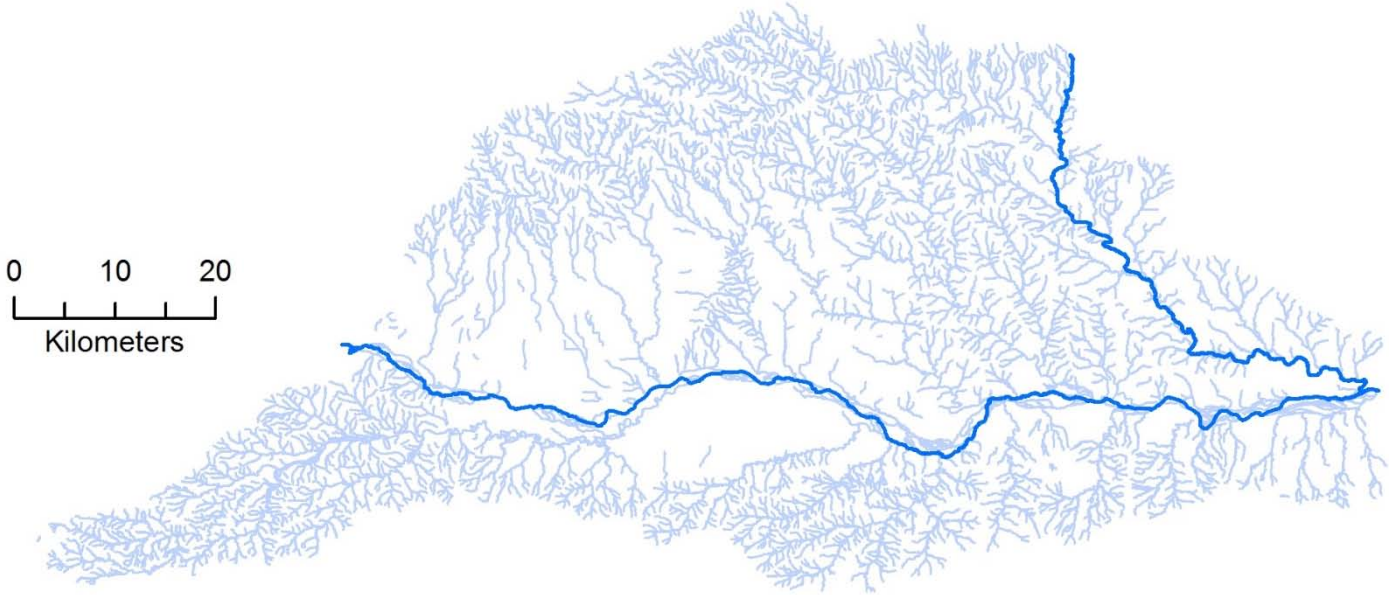
Solution 2: Outer Channel Algorithm

- Rationale
  - In some mapping situations, knowledge of braid extent as important as the primary channel
    - Useful for small scale mapping
  - Use longstanding cartographic convention applied to rail sidings
    - Retain outermost tracks to preserve overall shape / extent



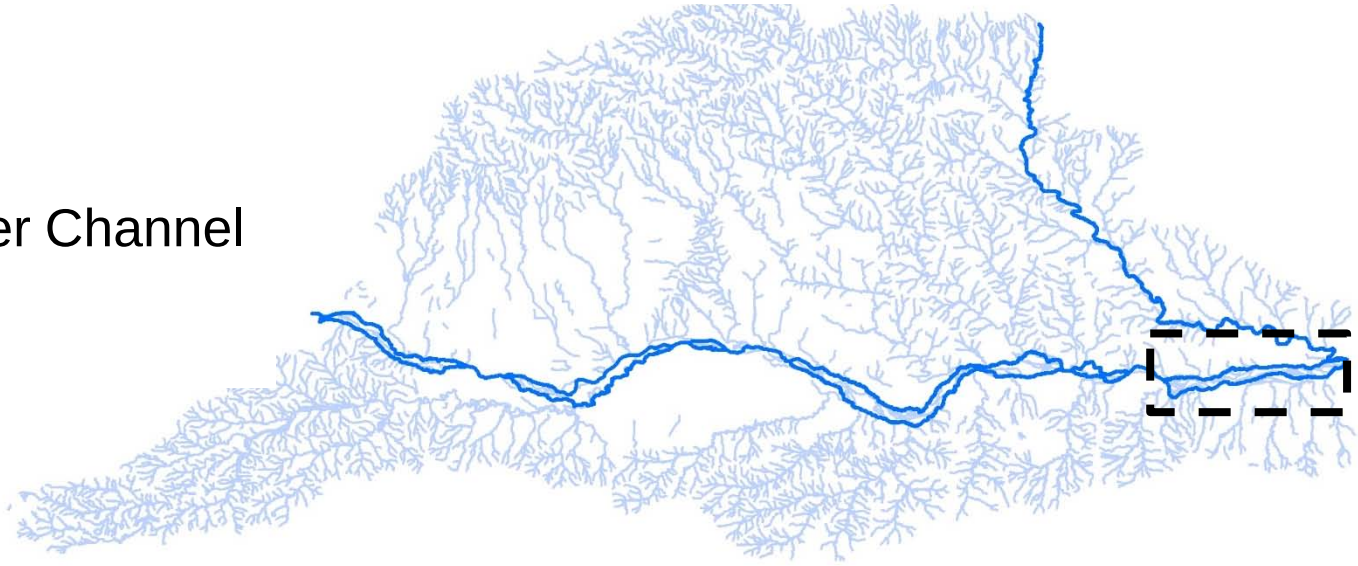
McMaster and Shea 1992: 60

Results



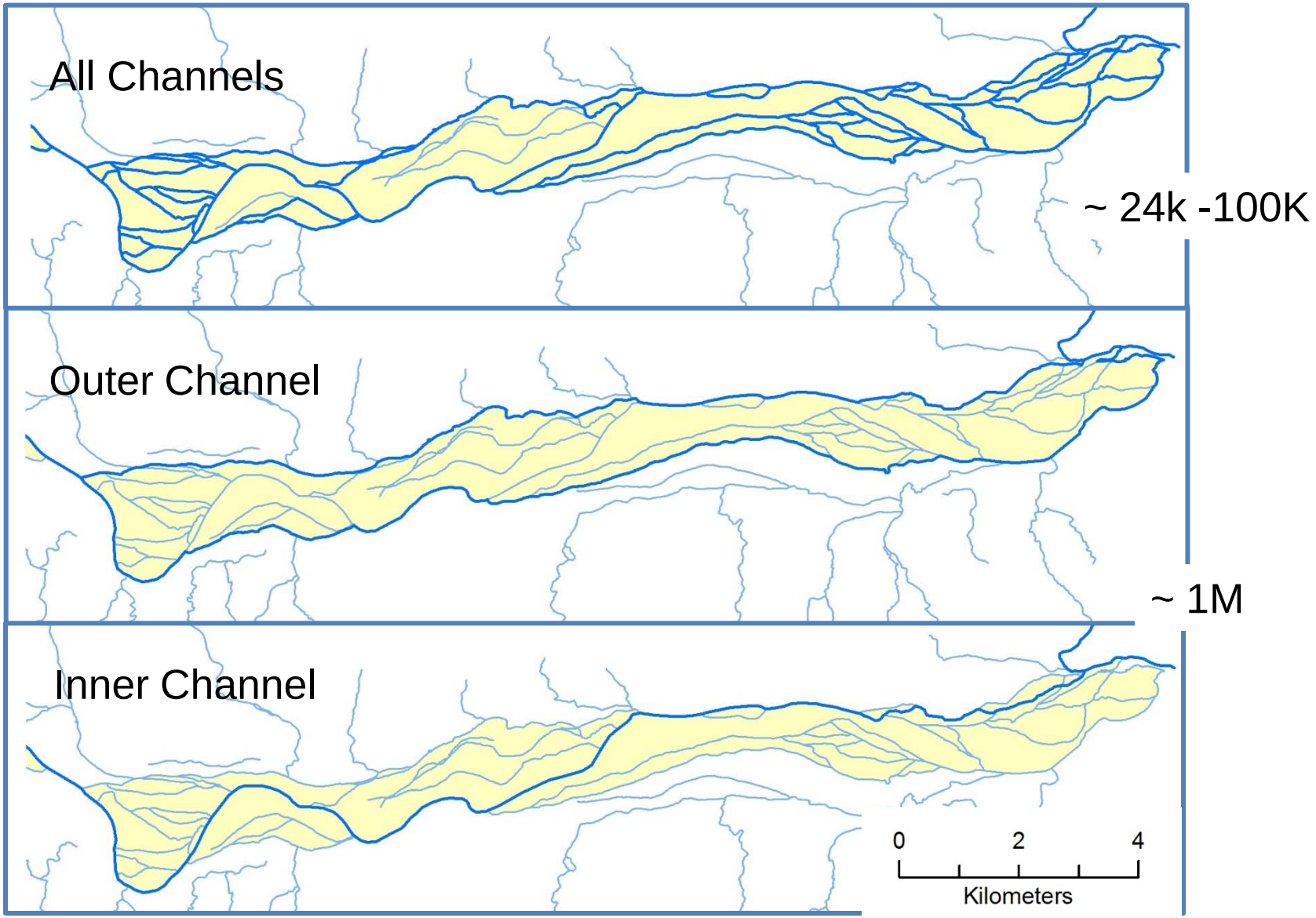
Solution 1 Inner Channel

Solution 2 Outer Channel



Lower Prairie Dog Town Fork Red River, Texas
HUC 8: 11120105
UDA CUTOFF = 20%

Algorithm Comparison

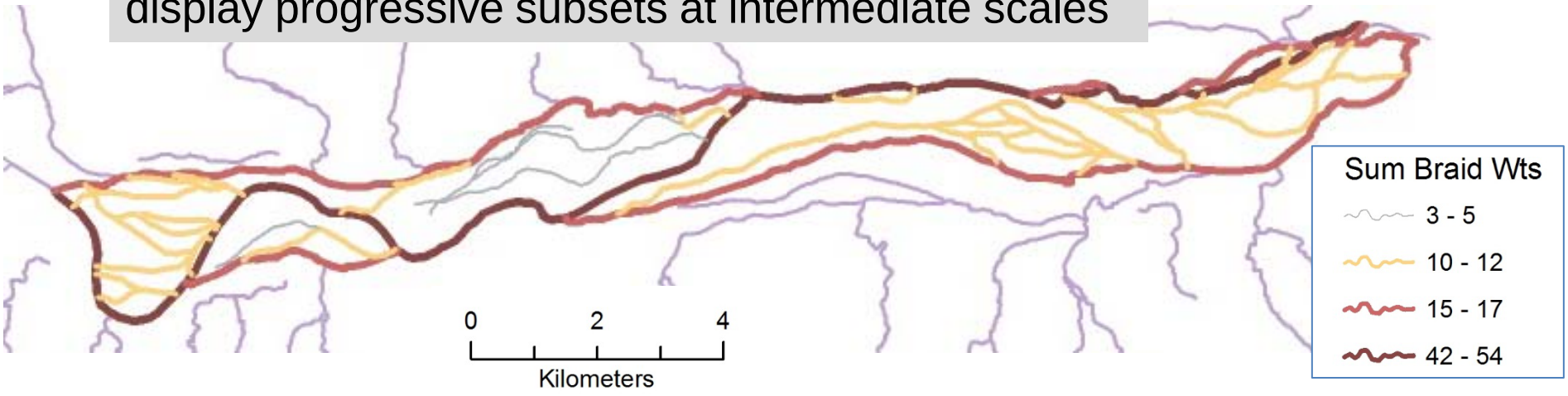


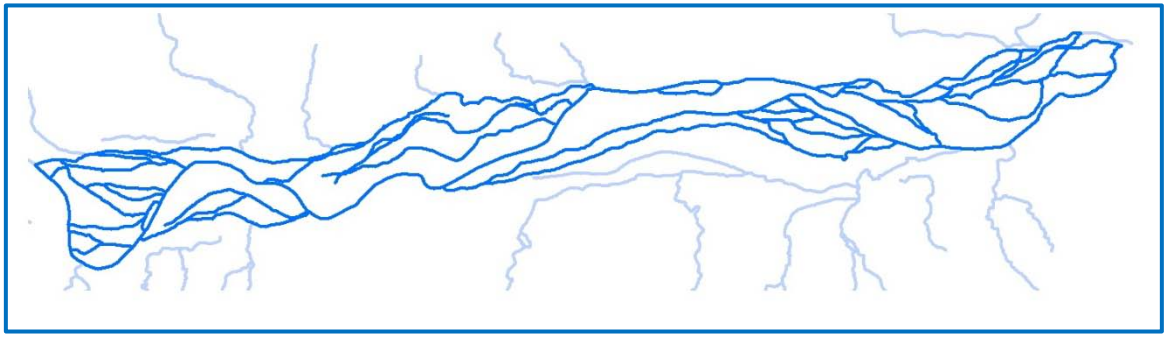
Solution 3: Weighted Channel Algorithm

flow_weights_braid_poly2

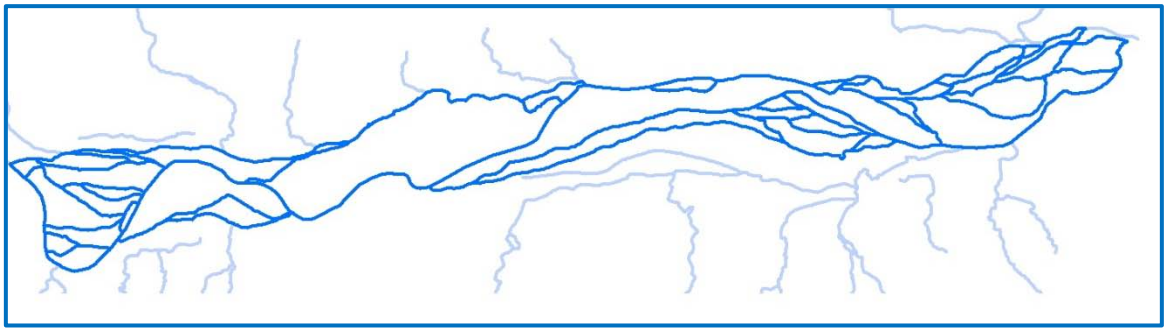
GNIS_Name	ReachCode	WBAreaC	FType	TOT_CM_SQ_KM	inr_pa	all_pat	outr_p	Braid_wt	GNIS_wt	Fcode_wt	inFcode_wt	IP_wt	OP_wt	UDA_wt
<Null>	11120105001474	91860479	558	3002273.48103	FLW	CTR1	CTR1	17	0	3	0	0	10	4
<Null>	11120105001475	91860479	558	3002299.484245	FLW	CTR1	CTR1	17	0	3	0	0	10	4
Prairie Dog Town For	11120105001533	<Null>	558	3002227.905993	CTR1	CTR1	CTR1	52	20	3	0	15	10	4
<Null>	11120105001534	<Null>	460	3002243.379563	FLW	CTR1	FLW	10	0	0	1	0	0	4
<Null>	11120105001534	<Null>	558	3002243.365024	FLW	CTR1	FLW	10	0	0	1	0	0	4
Prairie Dog Town For	11120105001535	<Null>	558	3002252.921182	CTR1	CTR1	FLW	42	20	3	0	15	0	4
Prairie Dog Town For	11120105001536	<Null>	558	3002253.17834	CTR1	CTR1	FLW	42	20	3	0	15	0	4
Prairie Dog Town For	11120105001536	<Null>	558	3002252.956609	CTR1	CTR1	FLW	42	20	3	0	15	0	4
Prairie Dog Town For	11120105001537	<Null>	558	3002254.119431	CTR1	CTR1	FLW	42	20	3	0	15	0	4
<Null>	11120105001539	<Null>	460	0.376885	FLW	FLW	FLW	3	0	0	1	0	0	2
<Null>	11120105001539	<Null>	460	0.370465	FLW	FLW	FLW	3	0	0	1	0	0	2
<Null>	11120105001539	<Null>	460	0.405738	FLW	FLW	FLW	3	0	0	1	0	0	2
<Null>	11120105001540	<Null>	558	3002244.278496	FLW	CTR1	FLW	10	0	0	1	0	0	4
<Null>	11120105001540	<Null>	460	3002244.275736	FLW	CTR1	FLW	10	0	0	1	0	0	4
Prairie Dog Town For	11120105001542	<Null>	558	3002268.803883	CTR1	CTR1	FLW	42	20	3	0	15	0	4
<Null>	11120105001543	<Null>	558	1.120726	FLW	FLW	FLW	5	0	3	0	0	0	2

Rank all flowline channels in braid polygon;
display progressive subsets at intermediate scales

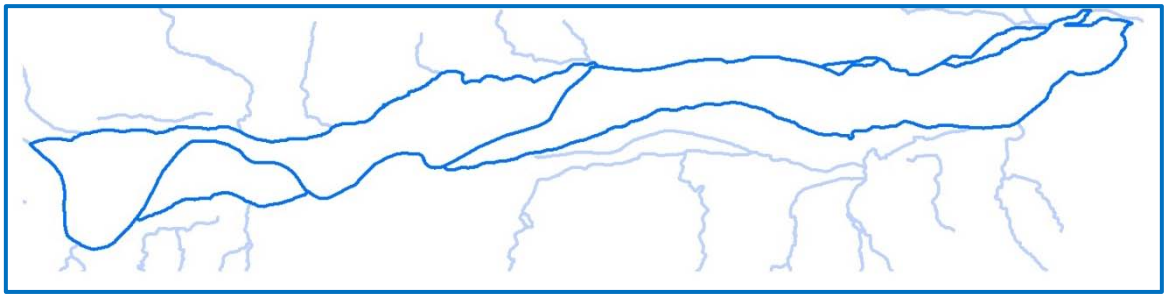




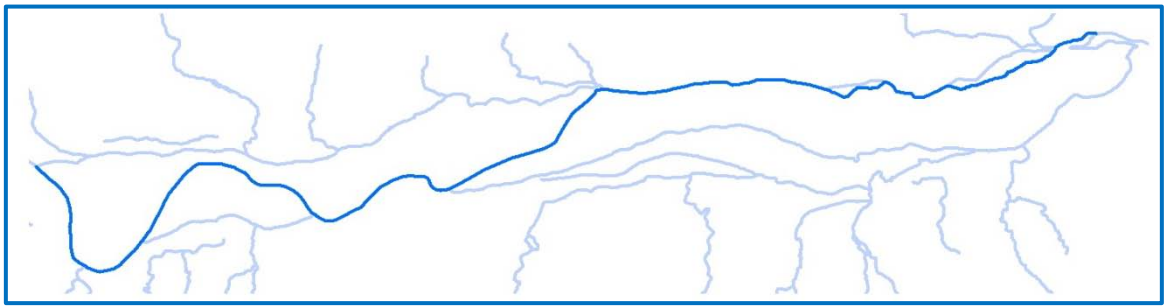
(wts 1-60)
All Paths



(wts 6-60)
Lose terminal channels



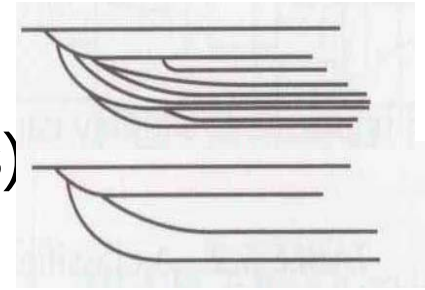
(wts 13-60)
Lose most internal connector channels



(wts 18-60)
Identical to Inner Channel solution

Summary of Weighted Channel Progress

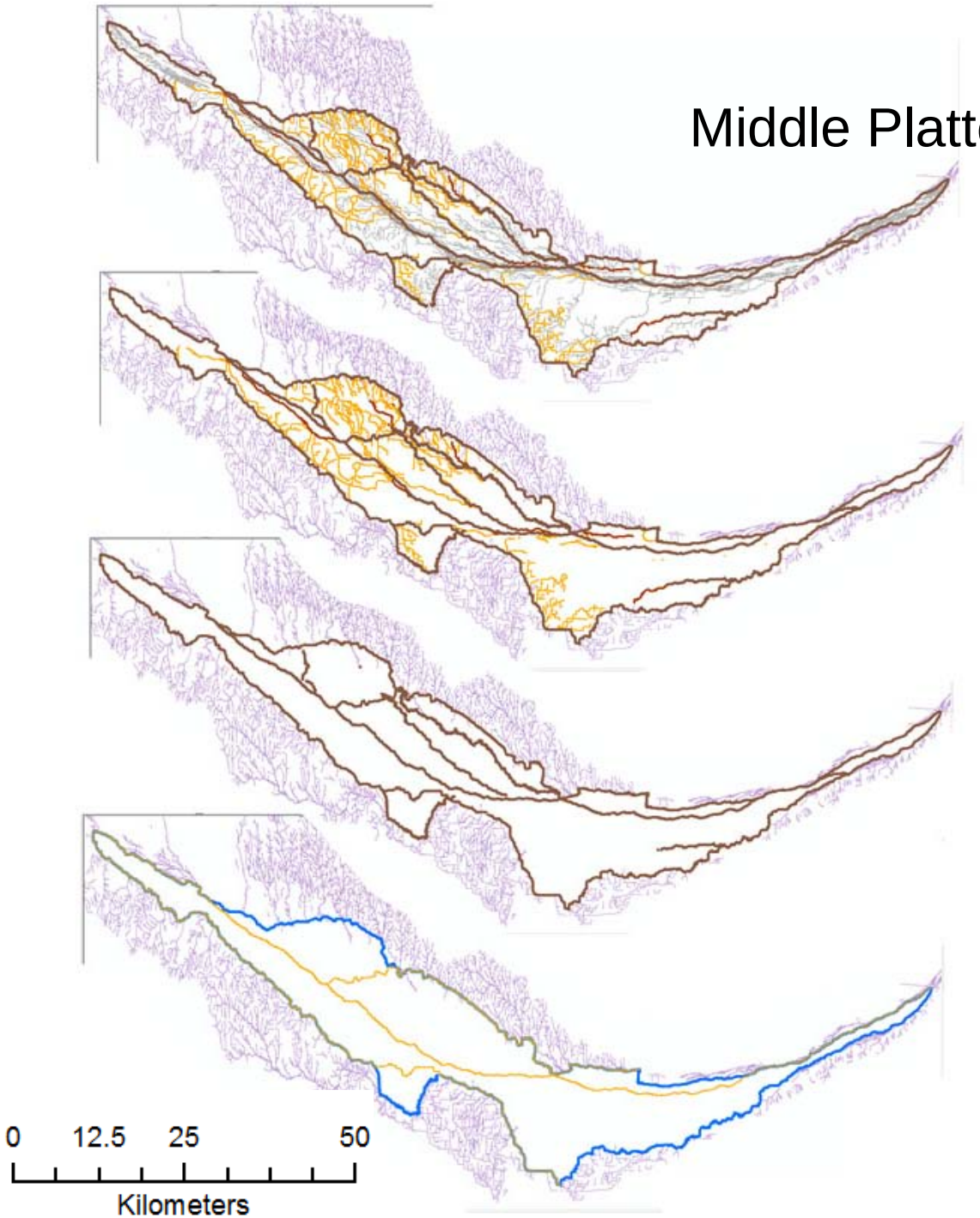
- Modified railroad siding analogy
  - Prioritizes braid extent & primary channel(s)
  - Protects channel connectivity
  - Continuous scale progression, no flicker
  - Braid weights as surrogate for stream order
  - Delineating primary channels instead of pruning data for large scale jumps – ICC paper Thursday



Slocum et al 2009
Thematic Cartography: 102

- Ongoing Tasks
  - Associate weights with specific scale ranges
  - Test other weighting schemes, larger braids, larger scale ranges

Courtesy Juan Solarzano
http://www.youtube.com/watch?v=I8-_ffXGpQk



NHD 10200101
Middle Platte-Buffalo Rivers, Nebraska

Sum Braid Wts
- 2 - 8
- 9 - 12
- 13 - 16
- 17 - 59

(wts 2-60)

All Paths

(wts 9-60)

Lose terminal channels

(wts 13-60)

Lose canals, ditches, irrigation pipelines

But not quite identical to Inner / Outer Channel solutions