Watershed and Stream Classification

for the Foothills Model Forest

Dogrib Fire
Delivery Data Set Description

Watershed and Stream Classification

Chisholm / Dogrib Fires Research Initiative

Foothills Model Forest

Delivery Data Set Description

The intention of this document is to outline the deliverables and to provide a detailed description of coverage attribute tables created for the Foothills Model Forest client for Dogrib fire study area. The required activities and entities are outlined in the process documentation available as a separate document.

The Dogrib CDROM contains single line hydrography, hydrography polygons, watersheds and Digital Elevation Model (DEM) data as binary ARC/INFO coverages (line, polygon, and grid types) prepared within ARC/INFO 7.2 environment. An ArcView 3.2 project, for data overview, are also provided. The projection and datum is UTM Z11, NAD 83 with double precision accuracy maintained throughout all processes.

GISmo Solutions Ltd. completed this project using data provided by the Base Features Project, Resource Data Branch, Alberta Sustainable Resource Development.

The general information, including this data set description document, is located in the OVERVIEW sub-directory. This sub-directory also contains study area boundary, and an ArcView project file allowing for easy display of provided information.

Dogrib   CDROM
 The following directories and files are provided on the delivery CDROM:

BF_HYDRO, BF_UPDATE, DOG_ACCESS, DOG_DEM, DOG_HYDRO, DOG_WORK_COV, OVERVIEW

BF_HYDRO
This directory contains source hydrography data from the Base Features project. All data sets were provided as seamless coverages (E00) with unique BF-id identifiers

Drb_slnet	A seamless SDE extracted set of SLNET data from RDB Data Distribution.
Drb_hydpoly	Seamless SDE HYDROPOLYS data from Data Distribution.
Drb_hydpoint	Seamless HYDROPOINTS data from Data Distribution.
info	ARC/INFO directory required for binary data structures.

BF_UPDATE

This directory contains three coverages and a .dbf table that represent proposed changes to the Base Features information. The coverages contain elements that would be changed spatially (either added or modified arcs), while the table lists BF_IDs corresponding to arcs that would be deleted (replaced with modified arcs), flipped or reassigned PS-flow.

miscoded   Coverage contains arcs that need corrections to ps-flow attribute.

flipped   Coverage contains arc that require flow directionality flipped. (original data incorrectly directed upstream).

added   Coverage contains arc that was added to connect major flows according to flow accumulation lines

drb_fliped.dbf   Table contains a list of BF_IDs that correspond at arcs requiring directionality edit.

drb_miscoded.dbf Table contains a list of BF_IDs that correspond at arcs requiring PS flow edit.

info   ARC/INFO directory required for binary data structures.

DOG_ACCESS

This directory contains source access data from the Resource Data, Data Distribution (Access Update project). All data sets were imported form provided export format coverages (E00).

Drb_cutlines   Cutlines data.
Drb_facil   Facility points
Drb_hydcarto   Annotation.
Drb_pipes   Pipelines.
Drb_power   Transmission lines
Drb_rails   Railways
Drb_roads   Roads.
Drb_acc_poly   Facility polygons.

DOG_DEM

This directory contains seamless source DEM coverage and some processed terrain information. DEM gird coverages were created using *TOPOGRID* and *FILL* ARC/INFO processes. Included here are contour coverages created for Quality Control (QC) before and after the utilization of *TOPOGRID* and *FILL* processes.

Specific files are as follows:

fdr_topo   DEM for extended user study area. The extended area covers all
1:20K tiles (buffered by 300 M) overlapping study area processed through
TOPOGRID and *FILL* to enforce a complete drainage. The required fill tolerance
was 14 M.. This DEM was used for watershed delineation. (FDR –
Filled **Dogrib** Topo)

Flow_ac_lin   A flow accumulation lines grid indicating patterns of flow on **fdr_topo**
(used in the QC process for validation of hydro network). Grid has a 25 m
resolution and 50 cells threshold.

fdr_hsh   A hillshade grid created from hydrologically adjusted surface with 35, 50 and
3 parameter values for sun location and vertical exaggeration.

org_in_con_10 A 10m contour for source data. This data set demonstrates source DEM
data errors.

in_con_10 A 10m contour for corrected source data (after QC for proper terrain
assembly).
to_con_10 A 10m contour after *TOPOGRID* (QC for impact of stream network
directional flows).

info   ARC/INFO directory required for binary data structures.

DOG_HYDRO

This directory contains a hydrography reaches and watersheds information requested by
client. Both shape coverages: reachpoints and drb_reaches contain attributes requested by
client. Watershed coverage (drb_wsd) corresponds to drb_reaches .

Specific files are as follows:

Drb_segs   Flow segments designed for topological routes used for reaches aggregation.
Individual gradients are compared and reaches are constructed by assigning an
absreach attribute.

Drb_reach Line coverage of reaches. Note: A unique reach is represented
by a single arc and may not be split by an in-flowing tributary. In a few specific
cases there are more than one arc per reach (when ArcInfo limitations for
maximum number of vertices are exceeded).

Drb_Reaches.shp Shape line coverage of reaches. Note: A unique reach is represented
by a single arc and may not be split by an in-flowing tributary. In a few specific
cases there are more than one arc per reach (when ArcInfo limitations for
maximum number of vertices are exceeded).

Reachpoints.shp Shape point coverage of reach downstream terminating points.
A unique reach is represented by a single point and there are two (or more) points at the confluence.
These correspond to locations where a topological break was created by software at:

Strahler class changes (Note: 1 into 3 inflow on the south edge does not create a break)
Crossing any polygon feature
At a confluence with a secondary flow of a higher order
As indicated by Hydropoints

Drb_wsd Final watershed drainage polygon coverage. In addition to individual "atomic" polygons an UPSTREAM region class stores aggregated regions.

Info   ARC/INFO directory required for binary data structures.

DOG_WORK_COV

This directory contains a classified single line stream network, identity coverage (after intersection with polygons) and some working files and coverages.

Specific files are as follows:

Drb_buf   Extended study area, where hydrological adjustment to DEM is completed**.**

Dsa_slnet   Dogrib Study Area single line attributed hydrography network

Did_slnet   Single line hydrography network intersected with polygon information (identity process)

dog_index 1:50K mapsheet neatlines used to create extended study area border

out_dog   An initial clipping polygon for study area (replaced by mask_500 derived out of watersheds later in the production).

Drb_lakes   Lakes polygon coverage for extended study area

Strahler.avl   ArcView Colour legend table for displaying Strahler classification

info   ARC/INFO directory required for binary data structures

OVERVIEW

This directory contains an outline of the study area, data documentation, and an ArcView 3.2 project for information display. The view comment fields (in view properties) provide additional information about the displayed data set.

Specific files are as follows:

Mask_drb   A mask shape polygon coverage (created from watershed coverage with a 500m buffer)

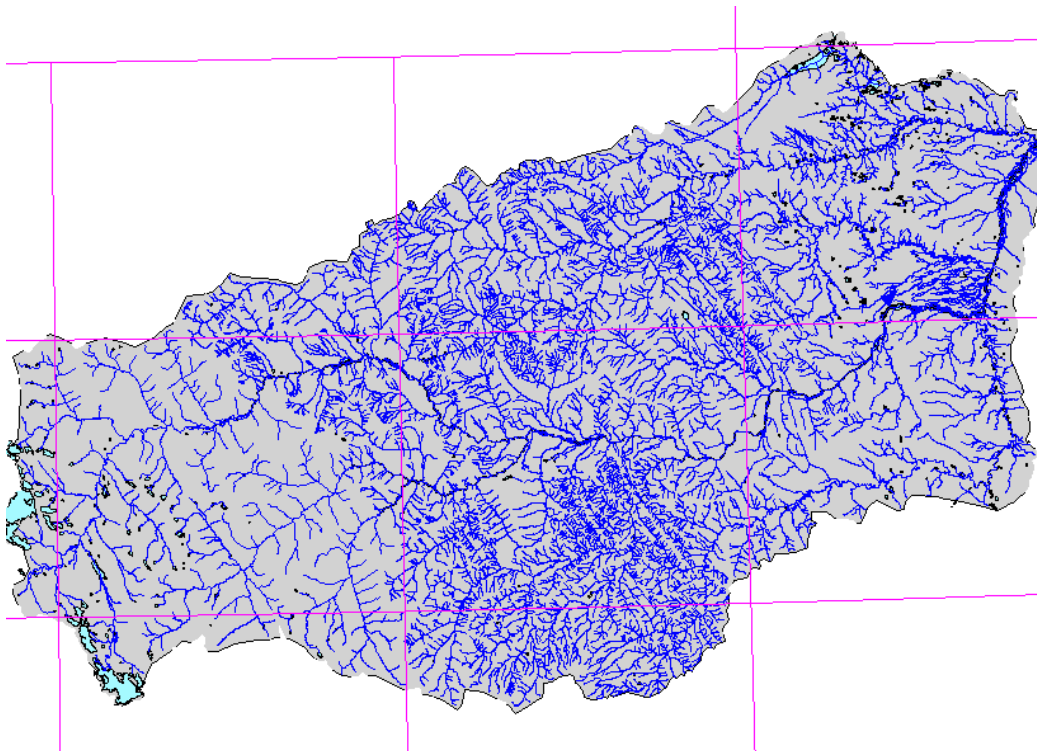**Visio**   Directory containing Data / Process Model documentation in VISIO / WORD format.

Dogrib_data_des.doc Microsoft WORD file, data description document.

Dogrib.apr   An ArcView 3.2 project providing data overview.

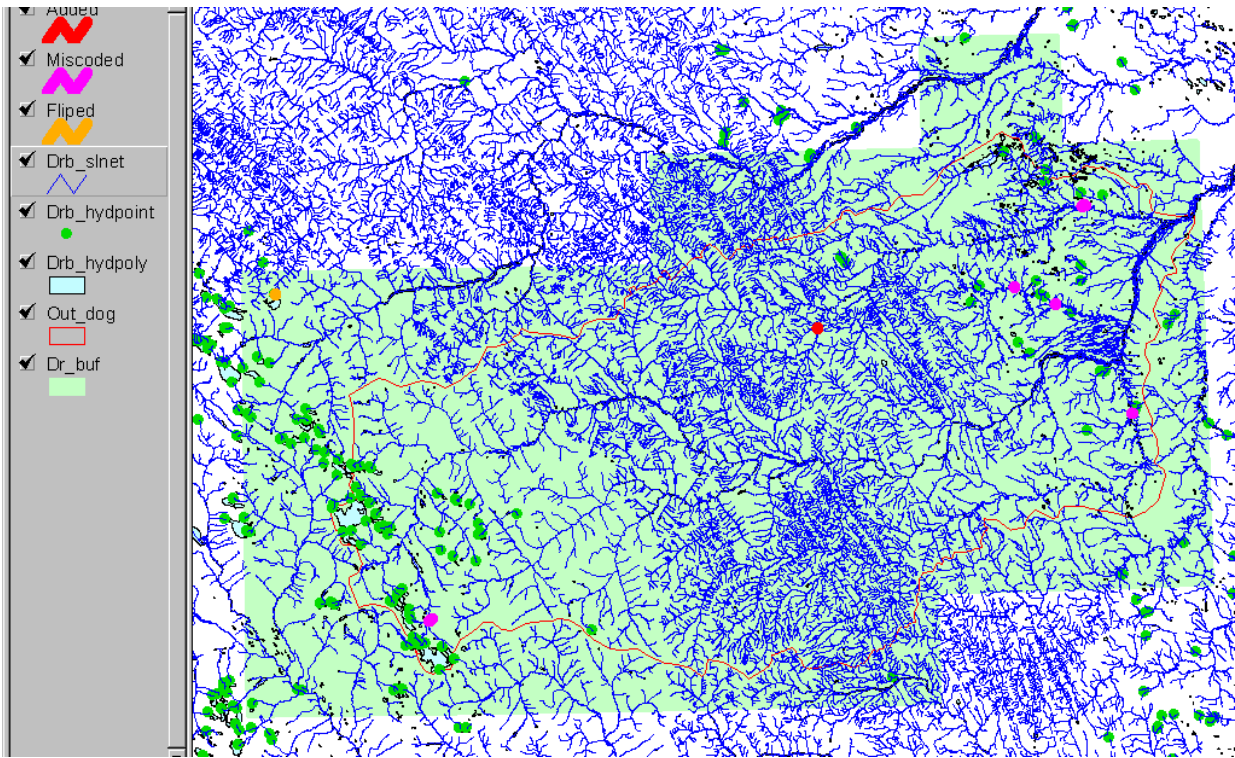The following views are provided in the **Dogrib.apr** project for client's reference:

01 Overview.
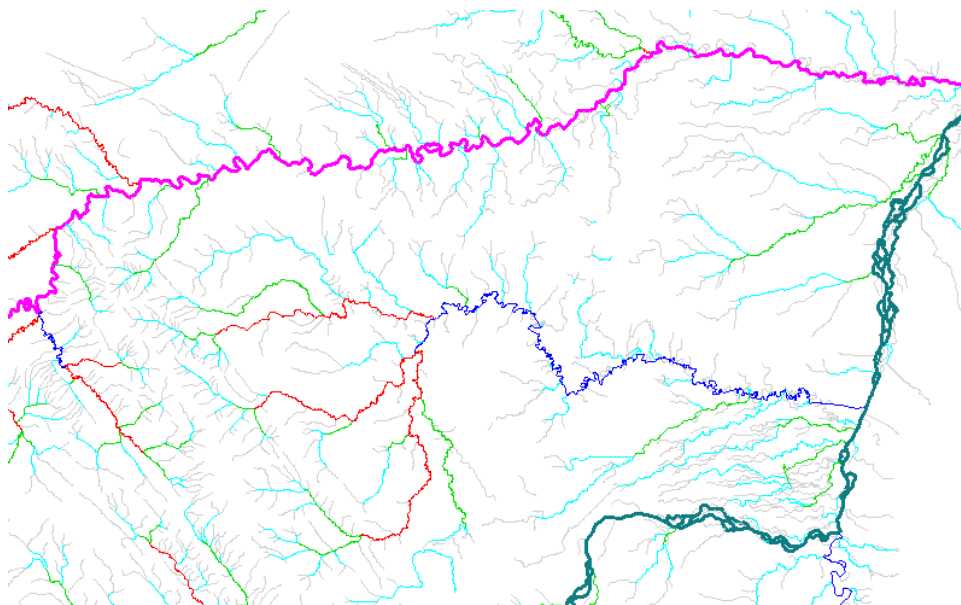   Overview of Dogrib Fire study area.

02   Source Data
Source hydrography data. Corrections to Base Features source data set are provided as additional separate coverages. The Drb_buf polygon outlines the extent of corrections to the DEM.

03   Strahler Classification
Strahler classification is applied to primary and secondary flows

04   Topological breaks

Topological breaks are created at:

Strahler class changes (Note: 1 into 3 inflow on the south edge does not create a break)

Crossing any polygon feature

At a confluence with a secondary flow of a higher order

As indicated by Hydropoints
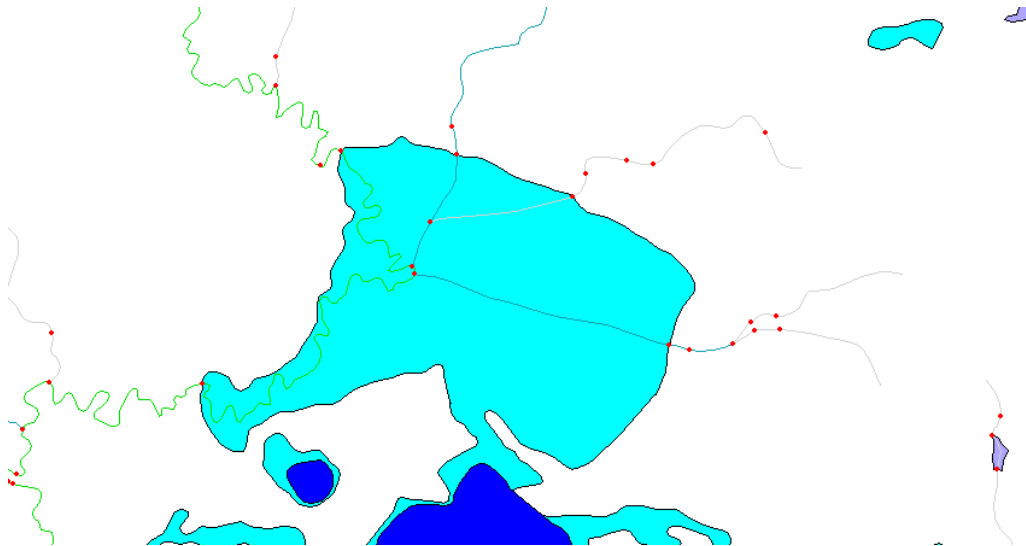
05   Segments and Reaches

Segments created on topological routes (primary flows only) are aggregated into reaches as per rules for gradient comparison. Topological break is never removed (Note: where a topological break is not present a full node topology is not enforced). Reachpoints with client attributes are created at a downstream node for every reach (so there are two of these at a confluence)
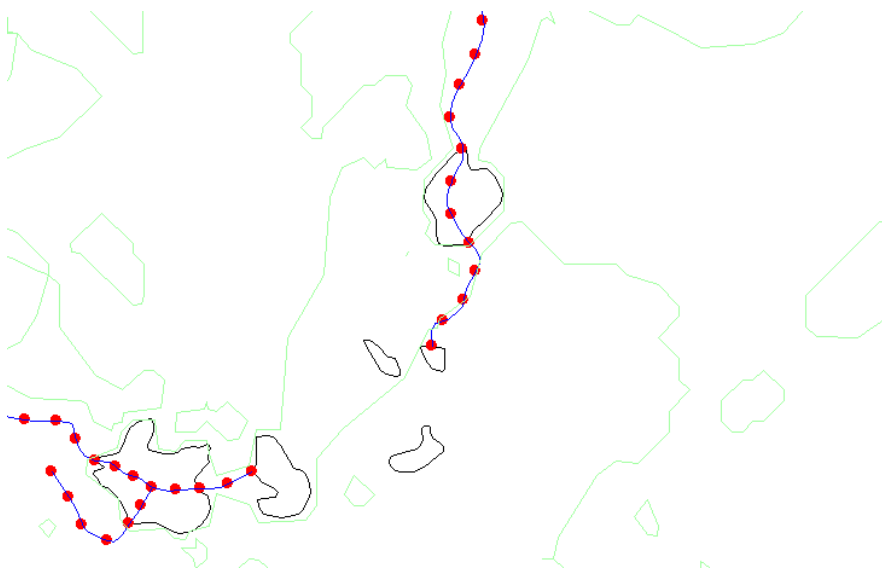
06 DEM data set.
View of the digital elevation model with mask.
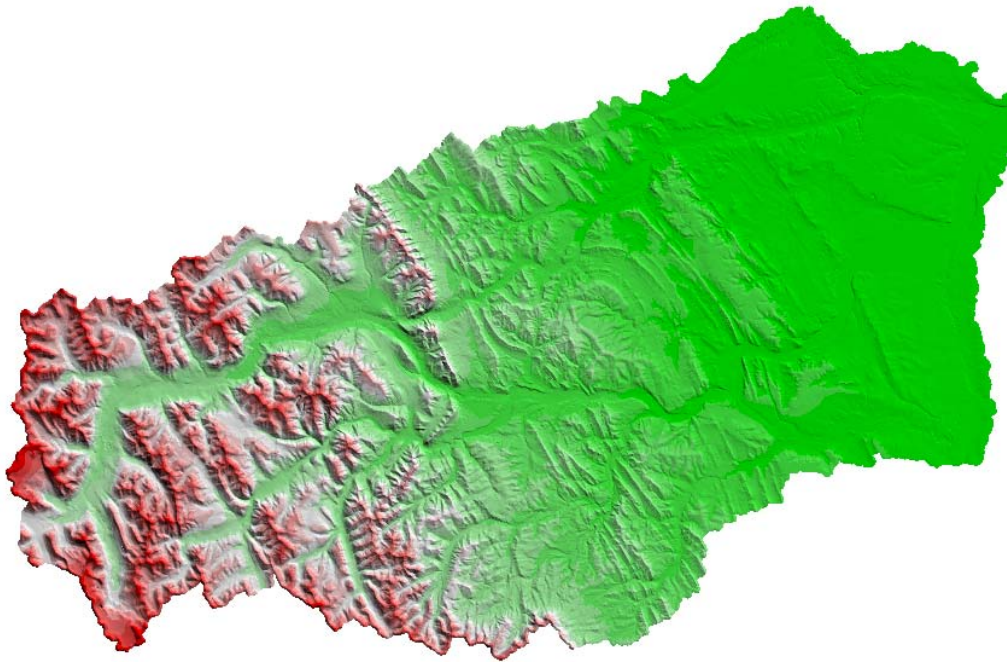
07 Flow Lines
There were no major discrepancies between flow accumulation lines and single line hydro flows. Minor cases as "A" are typical.
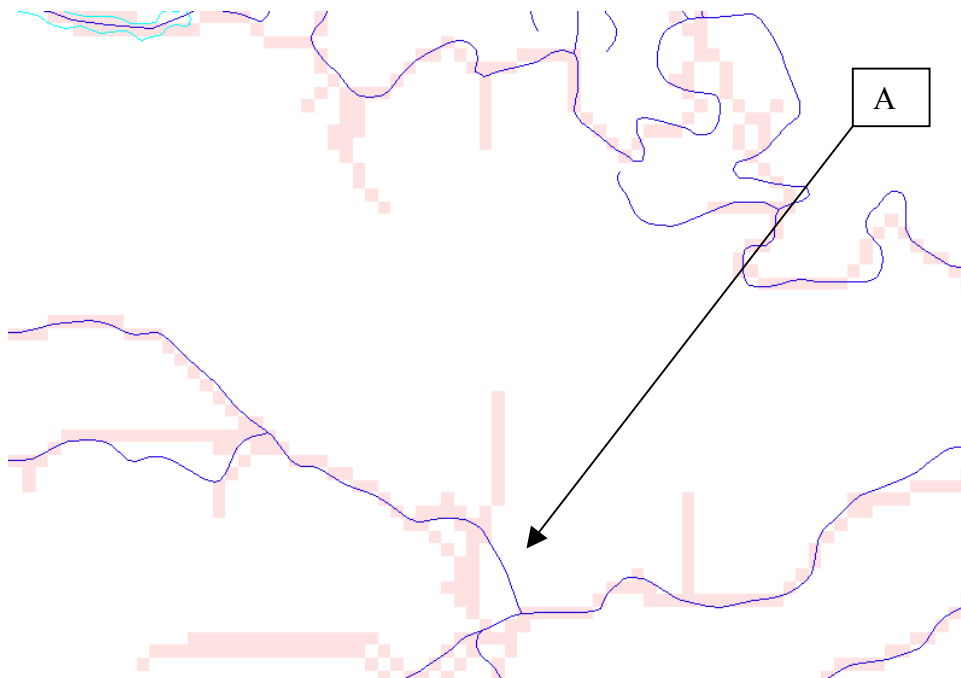
08 Reaches polygons and "Atomic"

Watershed polygons are created using ARC/INFO process that assigns a drainage area to individual arcs (reaches). The unique reach number "absreach" and the "grid-code" polygon attribute link the two data sets. Following the creation of watershed grids in raster domain, a corresponding polygon coverage is created and edited for accurate and pleasing cartographic representation.
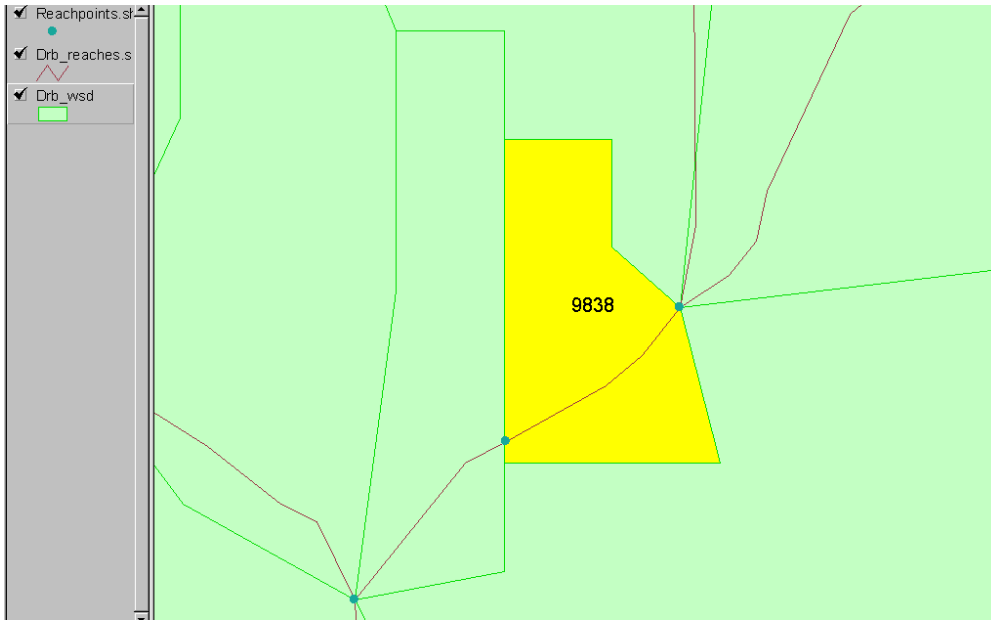
09 Watershed Reach Regions

Region class Upstream in DRB_WSD stores upstream drainage areas for all reaches. Attention: Do not querry or display the upstream layer !!!
Use selection tool to pick a region for a desired absreach number and convert it to a separate theme. This is only one upstream region per reach even for reaches with multiple segments.
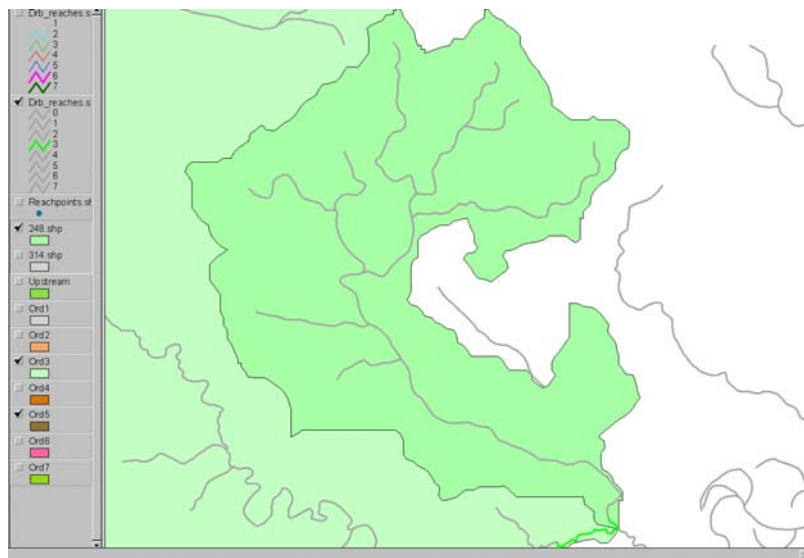
10   Classification of regions for Strahler sub-basins

A parent attribute was added to reaches and regions to identify
Sub-basins of specific Strahler class.
All regions of class 3 are available in ORD3
 region subclass.

DETAILED DESCRIPTION OF COVERAGE ATTRIBUTE TABLES

The following tables show all attributes for the final coverages for the Dogrib area. ARC/INFO
topological attributes, maintained Base Features attributes, and new attributes added in our
processes are identified for three coverages (with four corresponding feature attribute tables).

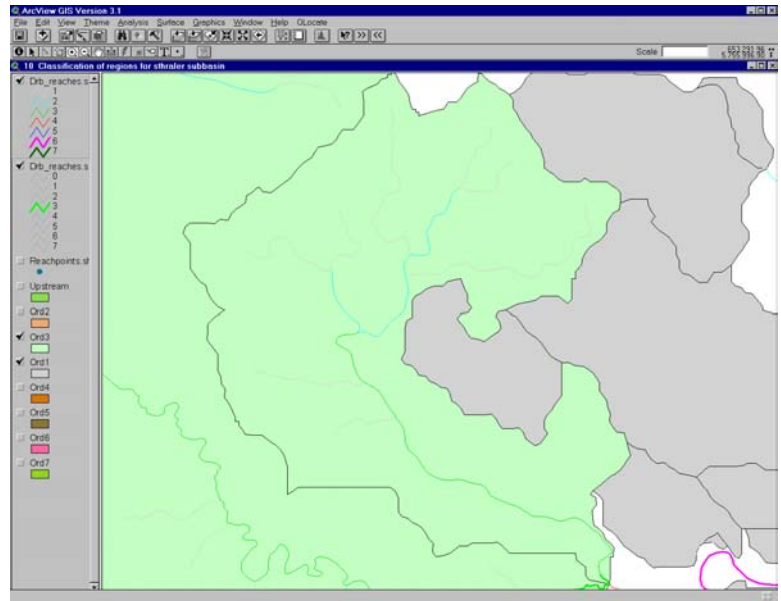|		
Drb_hydpoint	Drb_hydpoint.pat	point attribute table
Drb _hydpoly	Drb _hydpoly.pat	polygon attribute table
Dsa_slnet	Dsa_slnet.aat	arc attribute table
Did_slnet	Did_slnet.aat	arc attribute table
Drb _segs	Drb _segs.aat	arc attribute table
Drb _reaches	Drb _reaches.dbf	shape arc attribute table
Reachpoints	Reachpoints.dbf	shape point attribute table
Drb _wsd	Drb _wsd.pat	polygon attribute table
Drb wsd.upstream		UPSTREAM region class attribute table

DRB _HYDPOINT.PAT

NAME	ITEM DEFINITION			ITEM DESCRIPTION
AREA	8	18	F 5	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8	18	F 5	Perimeter in coverage units. Set to 0 for point features.
DRB_HYDPOINT#	4	5	B	Polygon internal sequence number (record number).
DRB _HYDPOINT -ID	4	5	B	Polygon feature identification.
FEATURE-CODE	10	10	C	Base Features Project Attributes (BFA)

FEATURE-TYPE	30	30	C	BFA	
NAME	80	80	C	BFA	
SOURCE	6	6	C	BFA	-||-
CAPTURE_DATE	8	10	D	BFA	-||-
BF_ID				BFA	

DRB_HYDPOLY.PAT

NAME	ITEM DEFINITION			ITEM DESCRIPTION
AREA	8 5	18	F	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8 5	18	F	Perimeter in coverage units. Set to 0 for point features.
DRB _HYDPOLY#	4	5	B	Polygon internal sequence number (record number).
DRB _HYDPOLY-ID	4	5	B	Polygon feature identification.
FEATURE-CODE	10	10	C	Base Features Project Attributes (BFA)
FEATURE-TYPE	30	30	C	BFA
NAME	80	80	C	BFA
SBFLAG BF_ID				BFA

DSA_SLNET.AAT

NAME	ITEM DEFINITION			ITEM DESCRIPTION
FNODE#	4	5	B	From-node sequence number.
TNODE#	4	5	B	To-node sequence number.
LPOLY#	4	5	B	Left polygon sequence number.
RPOLY#	4	5	B	Right polygon sequence number.
LENGTH	8	18	F5	Length in coverage units.
DSA_SLNET#	4	5	B	Arc internal sequence number (record number).
DSA_SLNET-ID	4	5	B	Arc feature identification.
FEATURE_CODE	10	10	C	BFA !!! Features were unsplit based on whether or not it is a lake.
FEATURE_TYPE	30	30	C	BFA !!! These attributes represent lakes or one of the feature code / type attributes for unsplit streams.
NAME	80	80	C	BFA -||-
SOURCE	6	6	C	BFA -||-
CAPTURE_DATE	8	10	D	BFA -||-
PS-FLOW	1	1	C	BFA !! Even if **sln** has only primary flows (based on SEC_SEG) original P and S values exist here.
SEC_SEG	1	1	C	Secondary Segment flag "P", "S" . If BF data was not changed in the QC process it corresponds to PS-FLOW attribute
STARTORDER	2	6	B	Attribute controlling classification for external inflows
STRORDER	2	6	B	Strahler class (1 - 6 in this set).

BF_EDIT_FL	1	1	I	Flag from correction process values 1 - 8 as described below 1. Miscoded PS. 2. Connectivity (this flag indicated "pour" point). Some are left open, many were modified by snap nodes or added segments. 3. (Delete) does not exist on final set. 4. Flipped arc. 5. Added. These segments are broken at lake border, but not fully attributed. 6. (Added from DEM, client approved). 7. Gap created. 8. Dogleg (zinger corrected).
EDIT_DET	15	15	C	Edit detail – description corresponding to BF_EDIT_FL
ERRORS	20	20	C	Error messages from initial route creation (name and P/S errors)
STARTLENGTH	4	8	B	Attribute allows for adjusting route construction priority on inflowing streams
SEG_NO	4	6	B	Sequential upstream segment number (route design attribute)
HI_ORD	4	6	B	Highest Strahler order (route design attribute)
DOM_NU	4	6	B	Route ID (route design attribute)
DOM_ID	4	6	B	Route ID of corresponding primary route (route design att. on S flow)
NEWROUTFLAG	2	1	B	New Route required flag (route design attribute)

DID_SLNET.AAT

NAME	ITEM DEFINITION			ITEM DESCRIPTION
FNODE#	4	5	B	From-node sequence number.
TNODE#	4	5	B	To-node sequence number.
LPOLY#	4	5	B	Left polygon sequence number.
RPOLY#	4	5	B	Right polygon sequence number.
LENGTH	8	18	F5	Length in coverage units.
DID_SLNET#	4	5	B	Arc internal sequence number (record number).
DID_SLNET-ID	4	5	B	Arc feature identification.
DSA_SLNET#	4	5	B	?
DSA_SLNET-ID	4	5	B	?
FEATURE_CODE	10	10	C	BFA !!! Features were unsplit based on whether or not it is a lake.
FEATURE_TYPE	30	30	C	BFA !!! These attributes represent lakes or one of the feature code / type attributes for unsplit streams.
NAME	80	80	C	BFA -||-
SOURCE	6	6	C	BFA -||-
CAPTURE_DATE	8	10	D	BFA -||-
PS-FLOW	1	1	C	BFA !! Even if **sln** has only primary flows (based on SEC_SEG) original P and S values exist here.
SEC_SEG	1	1	C	Secondary Segment flag "P", "S" . If BF data was not changed in the QC process it corresponds to PS-FLOW attribute

NAME				DESCRIPTION
BF_EDIT_FL	1	1	I	Flag from correction process values 1 - 8 as described below 1. Miscoded PS. 2. Connectivity (this flag indicated "pour" point). Some are left open, many were modified by snap nodes or added segments. 3. (Delete) does not exist on final set. 4. Flipped arc. 5. Added. These segments are broken at lake border, but not fully attributed. 6. (Added from DEM, client approved). 7. Gap created. 8. Dogleg (zinger corrected).
EDIT_DET	15	15	C	Edit detail – description corresponding to BF_EDIT_FL
STARTORDER	2	6	B	Attribute controlling classification for external inflows
STRORDER	2	6	B	Strahler class (1 - 6 in this set).
ERRORS	20	20	C	Error messages from initial route creation (name and P/S errors)
STARTLENGTH	4	8	B	Attribute allows for adjusting route construction priority on inflowing streams
SEG_NO	4	6	B	Sequential upstream segment number (route design attribute)
HI_ORD	4	6	B	Highest Strahler order (route design attribute)
DOM_NU	4	6	B	Route ID (route design attribute)
DOM_ID	4	6	B	Route ID of corresponding primary route (route design att. on S flow)
NEWROUTFLAG	2	1	B	New Route required flag (route design attribute)
DRB_HYDPOLY#	4	5	B	?
AREA	8	18	F5	?
PERIMETER	8	18	F5	?
DRB_HYDROPOLY-ID	4	5	B	?
SBFLAG	1	1	C	BFA -||-
POLY_FEAT	25	25	C	?
RECNO	2	5	B	Temporary work attribute

DRB_SEGS.AAT

NAME	ITEM DEFINITION			ITEM DESCRIPTION
FNODE#	4	5	B	From-node sequence number.
TNODE#	4	5	B	To-node sequence number.
LPOLY#	4	5	B	Left polygon sequence number.
RPOLY#	4	5	B	Right polygon sequence number.
LENGTH	4	12	F5	Length in coverage units.
DRB _SEGS#	4	5	B	Arc internal sequence number (record number).
DRB _SEGS -ID	4	5	B	Arc feature identification.
ROUID	4	4	B	Route ID identifier.
FROM	4	7	F4	Start point along the route.
TO	4	7	F4	Stop point along the route.
FR-SPOT	8	12	F3	Elevation reading at start point.
TO-SPOT	8	12	F3	Elevation reading at stop point.
GRAD-SG	8	12	F3	Gradient for the segment.
GRAD	8	12	F3	Gradient for the segment.
ABSREACH	2	5	B	Unique reach identifier.
CURREACH	2	5	B	Unique reach identifier with in unique route.
CLASS	2	2	B	Specifies class based on which aggregation was made.

FROMREACH	8	10	F3	Starting point along the route for the aggregated reach.
TOREACH	8	10	F3	Ending point along the route for the aggregated reach.
GRADREACH	8	10	F3	Gradient for the aggregated reach.

DRB _REACHES.DBF

NAME	ITEM DEFINITION			ITEM DESCRIPTION
FNODE#	4	5	B	From-node sequence number.
TNODE#	4	5	B	To-node sequence number.
LPOLY#	4	5	B	Left polygon sequence number.
RPOLY#	4	5	B	Right polygon sequence number.
LENGTH	8	18	F5	Length in coverage units.
DRB _REACHES#	4	5	B	Arc internal sequence number (record number).
DRB _REACHES-ID	4	5	B	Arc feature identification.
ABSREACH	4	6	B	Unique reach identifier.
IGNORESEG	1	1	C	Flag to help identify last arc for the reach.
DOWNELEV	10	3	DOUBLE	Elevation at the downstream node.
UPELEV	10	3	DOUBLE	Elevation at the upstream node.
RISE	10	3	DOUBLE	Rise(Upstream Elevation – Downstream elevation).
STRLNDIST	10	3	DOUBLE	Strait line distance from beginning to end.
VALLEYSLP	10	3	DOUBLE	Valley Slope.
CHANLEN	10	3	DOUBLE	Length of the channel.
CHANSLP	10	3	DOUBLE	Channel Slope.
SINUOSITY	10	3	DOUBLE	Sinuosity.
LOCDRAINA	10	3	DOUBLE	Local drainage area.
TOTDRAINA	10	3	DOUBLE	Total drainage area.
PARENT	4	5	B	Flag calculated for reaches that are parent reaches for sub-basins of specific Strahler class. (1,2…8)

REACHPOINTS.DBF

NAME	ITEM DEFINITION	ITEM DESCRIPTION
ID	5 0 INTEGER	Unique point identifier.
DOWNELEV	10 3 DOUBLE	Elevation at the downstream node.
UPELEV	10 3 DOUBLE	Elevation at the upstream node.
RISE	10 3 DOUBLE	Rise(Upstream Elevation – Downstream elevation).
STRLNDIST	10 3 DOUBLE	Strait line distance from beginning to end.
VALLEYSLP	10 3 DOUBLE	Valley Slope.
CHANLEN	10 3 DOUBLE	Length of the channel.
CHANSLP	10 3 DOUBLE	Channel Slope.
SINUOSITY	10 3 DOUBLE	Sinuosity.
LOCDRAINA	10 3 DOUBLE	Local drainage area.
TOTDRAINA	10 3 DOUBLE	Total drainage area.

DRB_WSD.PAT

NAME	ITEM DEFINITION	ITEM DESCRIPTION
AREA	8 18 F 5	Polygon area in coverage units. Set to 0 for point features.

PERIMETER	8	18	F 5	Perimeter in coverage units. Set to 0 for point features.
DRB _WSD#	4	5	B	Polygon internal sequence number (record number).
DRB _WSD-ID	4	5	B	Polygon feature identification.
GRID-CODE	4	8	B	Corresponds to reaches ABSREACH attribute.

DRB _WSD.UPSTREAM

NAME	ITEM DEFINITION			ITEM DESCRIPTION
AREA	8	18	F 5	Polygon area in coverage units. Set to 0 for point features.
PERIMETER	8	18	F 5	Perimeter in coverage units. Set to 0 for point features.
UPSTREAM#	4	5	B	Polygon internal sequence number (record number).
UPSTREAM-ID	4	5	B	Polygon feature identification.
ABSREACH	4	6	B	Reach identifier
PARENT	4	5	B	Parent flag calculated for regions that correspond to parent reaches for sub-basins of specific strahler class.

Information on reach aggregation for Dogrib area

Chisholm area used the aggregation rules option table 2 containing number of gradient classes (for segments), min max class segment gradient, % change parameter for aggregation.

Agg_rule_2.tab

9		Number of segment classes
-90 0	0	min, max class gradient , % change parameter
0	1	0.5
1	2	1.0
2	3	1.5
3	4	1.5
4	6	2.0
6	10	3.0
10	20	5.0
20	90	10.0

After reading the option table an Avenue script assigns abs_reach (and reach_grad) attribute as per rules.

Reach summary tool was applied to all reaches and to a selected group of reaches with length > 60m. An external ASCII summary option table 2 was used. Summary option table contains number of target reach classes, min max class reach gradient and class name attributes.

Summ_par_2.tab

10			Number of reach classes
−90.0	0.0	-1	min max Class
0.0	1.0	1	
1.0	2.0	2	
2.0	3.0	3	
3.0	4.0	4	
4.0	6.0	5	
6.0	10.0	6	
10.0	20.0	7	
20.0	40.0	8	
40.0	90.0	9	

An Avenue script applies reach classification and displays statistics ie. count, min, max, average length, average gradient for each reach class.

Results

All Reaches

Class	Count	Min Length	Max Length	Avg Length	Avg Grad
1	226	29.6	2860.5	317.5	-2.2
2	2765	4.9	17563.5	443.6	0.5
3	2445	5.8	12018.8	328.9	1.5
4	1991	6.1	3500.8	267.4	2.5
5	2050	7.2	6344.4	244.5	3.5
6	3284	5.1	3492.8	220.4	5.0
7	4292	3.8	2481.2	196.3	8.0
8	5976	4.8	3262.2	183.7	14.6
9	5471	4.8	5189.7	166.2	37.9

Total: 28500

Length over 60

Class	Count	Min Length	Max Length	Avg Length	Avg Grad
1	106	61.4	2152.8	260.9	-0.9
2	2537	60.1	17563.5	474.6	0.5
3	2346	60.1	12018.8	341.3	1.5
4	1914	60.4	3500.8	277.9	2.5
5	2006	60.7	6344.4	249.7	3.5
6	3194	60.3	3492.8	227.6	5.0
7	4213	60.2	2616.5	201.6	8.0
8	5871	60.3	3262.2	188.5	14.6
9	5418	60.1	5189.7	168.2	37.8

Total: 27605

Note: The elevation data accuracy and the calculated slope attributes for the reaches shorter than 60m may be misleading. Such short reaches could have both start and end elevation assigned from either value and gradient / slope attribute set to 0. Most of these short reaches were created due to the topological constraints such as crossing a lake, or connecting network segment in the double line river, and even adjusted DEM will not support precise reading of elevation data for these.