PNW River Reach File Documentation

Updated September 1997

1. Introduction

The U.S. Geological Survey (USGS) in Portland, in cooperation with Bonneville Power Administration, the Northwest Power Planning Council, and other Federal and state agencies and NW Indian Tribes produced a 1:100,000-scale River Reach data layer for the Pacific Northwest in the early 1990's. The Pacific Northwest (PNW) River Reach Files are a geo-referenced river reach data layer that encompasses the Columbia River Basin within the conterminous United States, the coasts of Oregon and Washington, Puget Sound in Washington, the Klamath and Goose Lake Basins in southern Oregon and the Bear Lake Basin in southeastern Idaho. The system is basically a 1:100,000 scale enhancement of the pre-existing 1:250,000 scale EPA River Reach File 2 (RF2).

This process was a primary task of the PNW River Reach Project because these reach identifiers are an integral hydrologic component in a regional rivers and fisheries information system now known as StreamNet (formerly the Coordinated Information System (CIS) and the Northwest Environmental Database (NED)). StreamNet is an ongoing effort by federal, state, and tribal organizations within the region to compile reach and stream specific information pertinent to the Region's fish and wildlife resources in Oregon, Idaho, Washington, and Montana. The PNW Reach Files carry the U.S. Environmental Protection Agency's (US EPA) river reach numbers. The system was transferred over to the StreamNet project at Pacific States Marine Fisheries Commission (PSMFC) in early 1997 for maintenance, enhancement, and distribution. PSMFC is also the lead contractor responsible for supervising the integration and conversion of the PNW Reach Files into the new National Hydrograpy Dataset.

1.1 Methodology

The PNW River Reach Files were constructed using ARC/INFO versions 4.0 and 5.0. A unique conflation algorithm was developed by the USGS that transferred the reach identifiers from the RF2 to the new 1:100,000-scale hydrography. The 1:100,000-scale hydrography were constructed from scanned 1:24,000 and 1:63,000-scale separates and then edited. Most, but not all hydrographic features found on these two larger scale products will be found in the PNW Reach Files. The PNW Reach Files are a linked stream network. ARC:NETWORK utilities were used on the Reach Files to provide attribute information that would allow a user to perform directional routing upstream or downstream from a given starting point using either a GIS or by using items, such as UPLINK1,2,3 PNTR# and DOWNLINK found in the Arc Attribute Table. Water body

features such as lakes, reservoirs, defined wetlands, double-banked streams, and others were moved to a separate 'banks' coverage and represented in the Reach File with centerlines and tributary connectors arcs. Reach files are organized by USGS hydrologic unit codes (HUC's - also known as a cataloging units) and are designed to provide users with a 1:100,000-scale reach structure for performing various types of hydrologic applications. Every reach in the Reach File has been assigned a unique but stable reach identifier (17 character river reach number comprised of the 8 digit HUC, the 4 digit segment number (SEG), and the 5 digit reach mile point). New reaches in the system were numbered starting with SEG = 500 providing a unique way to locate all new arcs in the system.

The following is a generalized list of procedures followed to construct the PNW River Reach Files. The USGS Open File report mentioned in the .DOC will include all of the processing macros written to assist in the Reach File development.

Generalized procedures for constructing 100K scale Reach Files

1. Read 100K hydrography DLG's for each map into GIS.
2. Edgematch north and west edges of each map to adjacent 100K quads.
3. CLIP each 100K quad with adjusted Hydrologic Unit boundary.
4. APPEND clipped quad pieces together.
5. Correct internal node errors using automated snapping.
6. Remove non-attributed pseudo nodes.
7. Copy polygons to Waterbody coverage.
8. Edit out double-banked streams, shorelines,and braided areas and put into Water bodies coverage.
9. Add centerlines through waterbodies and wide streams and connector arcs from centerlines to tributaries.
10. Create Trace coverage from EPA Reach File.
11. Edit Trace, correcting stream names and topologic structure where
12. Adjust Trace segment endpoints to align with corresponding 100K endpoint.
13. CONFLATE (Transfer) Trace-ID from Trace reaches to corresponding reaches in 100K coverage.
14. Make check plots to verify results of conflation.
15. Transfer EPA extended attributes (SEG, LEVEL, SEQNUM, FLAG) to 100K reaches.
16. Assign unconflated 100K reaches a provisionary reach code.
17. Move provisionary codes to SEG.
18. Add State, County, and quad boundary items to reaches in 100K-scale Reach File.
19. Compute sinuosity for each reach.
20. Block man-made waterways, braided reaches, and other features determined as not part of the basin network by calculating their LENGTH item to negative.
21. Determine allocation centers. Usually mouth of basin.

22. ALLOCATE from centers.
23. WRITEALLOCATION ROUTING results to Reach File Arc Attribute Table.
24. Use DIRECTION item to flip reaches to flow in a downstream direction
25. Calculate PNTR# to internal record number of Arc Attribute Table
26. Unblock previously blocked arcs.
27. Calculate river mile for allocated reaches.
28. Compute upstream linkage. INFO program.
29. Order attributes in Reach Files and Water bodies coverage for consistency among Files.
30. Check Reach File using checking programs.
31. Manually add Northwest Power Planning Council reach codes, stream names and river miles.
32. Run final check programs
33. Archive Reach Files.
34. Distribute to states for review.

1.2 New Features

PSMFC has, via the StreamNet project, made several major enhancements in the PNW River Reach file which are now incorporated in the system. The major enhancement has been the addition of a new attribute which allows the for the development and use of a *stream based* routing system.

The impetus and methodology for deriving the new *stream based* identifier was developed by an interagency committee that was formed under the President's 1993 Forest Plan. The Interorganizational Resource Information Coordinating Council (IRICC), comprised of representatives from federal, state, tribal, and local entities, was tasked with developing data standards that could be used across agency boundaries that would facilitate implementation of the Forest Plan. They recognized that for stream related data, a comprehensive and regionally standard hydrologic system was necessary to ensure that data could be readily collected and shared between agencies. They further recognized that the utility of such a system would be greatly enhanced if a method for identifying a given *stream* within the hydrologic coverage was available. After looking at the various options available in the region, the IRICC group officially adopted the PNW Reach File system as the base hydrologic layer and developed a new attribute called the Longitude/ Latitude ID (LLID) for use in uniquely identifying *streams.*. This attribute consists of the longitude and latitude of the mouth of the stream. All *reaches* (or arcs) that comprise a given *stream* were to be assigned a unique LLID. Longitude would precede latitude to conform with standard x,y ordering. The code will be 13 characters long, with 7 for decimal degrees of longitude and 6 for decimal degrees of latitude, with implied decimal points.

After the IRICC decision, a fast track effort was put in place to add the new LLID field to the PNW Reach File and this effort is largely complete (all streams in OR and WA, named streams in ID). In the PNW Reach File a *stream* is defined a series of contiguous arcs comprising a waterway with identical values in the FEAT_NAME field. Only arcs representing the transport path of water (stream, braided stream, some canals, and centerlines and connector arcs within lakes and reservoirs) with a SAVENEG value of NO were included. For features that were unnamed, stream ID's were applied visually using best professional judgment.

StreamNet has used the new LLID as the basis for building a regionally consistent stream routing system. By using this routing system, one can exploit the benefits of ArcInfo's dynamic segmentation, including the use of *event tables* for data collection and sharing. We believe this is a significant enhancement to the reach file which will greatly facilitate its use.

Other enhancements made include the addition of an open water name field (OW_NAME) that has been populated, where possible, with the name of the reservoir or lake in which the centerline of a given stream lies. The FEAT_NAME field is then reserved for the name of the stream or river. Three additional fields were added in order to facilitate more straightforward use and queries of the USGS minor code fields. We found that the population of these fields (MINOR1, MINOR2, MINOR3) by all of the various entities who worked on the reach file over the years was inconsistent making it very difficult to find certain arc types (for example, all centerline arcs within reservoirs). By generalizing the minor coding into 3 new fields (PRIMARY, SECONDARY, and DESCRIPTOR) we feel we have added some new flexibility in finding certain reach types.

The PRIMARY attribute is non-null item that provides a generalized description of the arc type.

Codes, description and approximate arc counts are shown here:

Code	Description	Count
101	Reservoir	2178
199	Island	68
200	Shoreline (Pacific Coast)	1283
412	Stream	247402
413	Braided Stream	8324
414	Ditch or canal	14342
415	Aquaduct	395
416	Flume	13
417	Penstock	9
418	Siphon	100

420	Wash or ephemeral drain	25
421	Lake or pond	6558

The SECONDARY attribute is non-null item that differentiates between a normal 1-d feature (code 0), centerlines (999), and pigtails (990), as well as several misc. circumstances.

Code	Description	Count
0	N/A	249925
202	Closure Line (water-water)	1202
204	Apparent Limit	13
990	Connector Arc	8955
998	Added arc to connect lines at map boundaries	383
999	Centerline	20219

The DESCRIPTOR attribute is non-null item that provides additional information about the arc. For example, a primary type of 200 (shoreline) may have a descriptor of 116 (bay).

Code	Description	Count
0	N/A	171565
105	Inundation area	46
111	Marsh- wetland- swamp- bog	1008
116	Bays- estuaries- gulfs- oceans- seas	1451
601	Underground	193
602	Overpassing	50
603	Elevated	6
604	Tunnel	44
610	Intermittent	105399
614	Dry	7
617	Underpassing	928

1.3 Descriptors:

River Reach File, Hydrography, Catalog Unit, Hydrologic Unit, 100K-scale, LLID

2. PNW Reach File Applications

2.1 Intended use of data

Many different types of GIS analysis can be performed on the Reach Files. These might include buffering around reaches, stream network routing, basin characteristics analysis or dynamic segmentation. Furthermore, the system provides an ideal environment for storing, organizing, and displaying stream related fisheries and habitat data.

2.2 Limitations of data

The PNW River Reach Files were compiled from 1:100,000-scale Digital Line Graphs for hydrography, which were constructed from scanned 1:24,000 and 1:63,000-scale separates and then edited. The county boundaries coverage was at 1:500,000-scale. This lower resolution may have caused some reaches to be incorrectly coded for COUNTY and COUNTY-2. Not all stream reaches have been named. None of the water body features were named or coded with a unique identifier. Stream ID's (LLID) have only been assigned to named streams in Oregon, Washington, and Idaho, and unnamed streams in Oregon and Washington.

3. PNW River Reach File Data Dictionary

3.1 STR100-PNW.AAT

Following is a description of attributes for a given reach in the Arc Attribute Table:
MATT - CHECK FIELD ORDER HERE AND BELOW - also - do we need to add a section describing the RAT table??
File name: [PNWRRF].AAT

ATTRIBUTE NAME	DESCRIPTION
FNODE#	ARC attribute - downstream node number
TNODE#	ARC attribute - upstream node number
LPOLY#	ARC attribute - identifies polygon number to the left of the arc when polygon topology has been computed.
RPOLY#	ARC attribute - identifies polygon number to the right of the arc when polygon topology has been computed.
LENGTH	Arc length in feet.
STR100-PNW#	ARC attribute - internal record number.
STR100-PNW-ID	ARC attribute - assignable User-ID number
MAJOR1	NMD DLG base category identifier. 50 identifies feature as hydrography.
MINOR1	NMD feature classifier. 412 identifies the feature as a stream 999 was used to indicate artificial features such as center-

MINOR2	NMD feature classifier. Descriptive code of 610 identifies the featurestream, (412) as intermittent.
MINOR3	NMD feature classifier. Rarely used for hydrography. Code of 111111 was used to indicate outlet reach for the basin, 888888 indicated headwater reach.
HUC	8 digit USGS Hydrologic Unit Code number.
SEG	Reach segment number.
RMI	River Mile marker. Distance in miles. Lowest reach of each unique SEG number has an RMI value of 00.00.
FEAT_NAME	Hydrographic feature name. Sources for stream names were from USEPA 1:250,000 scale Trace graphic files, 1:100,000-scale manuscripts, and NMD Geographic Names database. Additional stream names were added from available map resources.
FEAT_SRC	Source of hydrographic feature. A1 - Origin of feature was from NMD 1:100,000-scale DLG, A2 - digitized from 1:100,000-scale manuscript, A9 - manually added feature using GIS editor. B1 - Origin was from NMD 1:24,000-scale DLG, B2 - feature was digitized from 1:24,000-scale manuscript, * note: these codes can be expanded to include features obtained from larger scale maps or GPS acquired data.
STATE	Predominant state that a particular reach falls within.
STATE-2	Second most predominant state a particular reach falls within.
COUNTY	Predominant county a particular reach falls within.
COUNTY-2	Second most predominant county a particular reach falls within.
QUAD100	Predominant 1:100,000-scale quad a particular reach falls within.
QUAD100-2	Second most predominant quad particular reach falls within .
QUAD75	Predominant 1:24,000-scale quad a particular reach falls within.
QUAD75-2	Second most predominant quad a particular reach falls within .
CEN	Node number of allocation center a reach was allocated from. Non -Allocated reaches have a CEN value of 0. Results from ALLOCATE can be displayed in ARCPLOT.
CUMLENGTH	Cumulative length of arcs traversed from any allocation center.
DNARC	Down arc. The internal record number (cover#) of the previously allocated arc.
PNTR#	A record of the order of the Arc Attribute Table at the time
SAVENEG	Flag item that preserves a record of the features that were blocked prior to ALLOCATION. Value of 1 means a feature has been blocked.
SINUOUS	Ratio of the true distance of a reach over its straight line
UHUC1	Hydrologic Unit Code number of the first upstream reach for a particular reach.
UPNTR1	Pointer number (PNTR#) of first upstream reach.
UHUC2	Hydrologic Unit Code number of the second upstream reach for a particular reach.
UPNTR2	PNTR# of second upstream reach.
UHUC3	Hydrologic Unit Code number of the third upstream reach for a particular reach.
UPNTR3	PNTR# of third upstream reach
UFLAG	Flag item to indicate the presence of a fourth upstream reach for a particular reach. If true, UFLAG is set to 1.
DHUC	Hydrologic Unit Code number of downstream reach.
DPNTR	PNTR# of downstream reach.

CSEG	Northwest Power Planning Council (NPPC) added reach code.
CRMI	River mile designation assigned to NPPC reaches.
CNAME	Stream name of NPPC reaches.
RRN	Unique River Reach Number
LLID	Item used to group arc's into distinct routes based on FEAT_NAME (see discussion above)
OW_NAME	open water feature name of centerline arcs within large water bodies (see discussion above)
PRIMARY	aggregation of minor codes (see discussion above)
SECONDARY	aggregation of minor codes (see discussion above)
DESCRIPTOR	aggregation of minor codes (see discussion above)

Following is a list of items contained in the water body Polygon Attribute and Arc Attribute Tables:

File name: BANKS-PNW.PAT

ITEM	DESCRIPTION
AREA	ARC attribute. Area of a polygon in map units.
PERIMETER	ARC attribute. Perimeter of a polygon in map units.
BANKS-PNW#	ARC attribute. Polygon internal number.
BANKS-PNW-ID	ARC attribute. User assignable polygon-ID number.
MAJOR1	NMD category code. Value of 50 indicates hydrography
MINOR1	NMD feature code identifier.
MINOR2	NMD feature code identifier
MINOR3	NMD feature code identifier.
HUC	Hydrologic Unit Code

File name:BANKS-PNW.AAT

ITEM	DESCRIPTION
FNODE#	ARC attribute. From-node number.
TNODE#	ARC attribute. To-node number.
LPOLY#	ARC attribute. Polygon to left of arc in F-T node direction.
RPOLY#	ARC attribute. Polygon to right of arc in F-T node direction.
LENGTH	ARC attribute. Length of arc in map units.
BANKS-PNW#	ARC attribute. Arc internal number.
BANKS-PNW-ID	ARC attribute. User assignable arc -ID number.
MAJOR1	NMD category code.
MINOR1	NMD feature code identifier.
MINOR2	NMD feature code identifier.
MINOR3	NMD feature code identifier.

Following are the Item format tables for the Reach File and associated coverages.
Datafile name: [PNWRRF].AAT

44 ITEMS: STARTING IN POSITION 1

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	FNODE#	4	5	B	-	
5	TNODE#	4	5	B	-	
9	LPOLY#	4	5	B	-	
13	RPOLY#	4	5	B	-	
17	LENGTH	4	12	F	3	
21	STR100-PNW#	4	5	B	-	
25	STR100-PNW-ID	4	5	B	-	
29	MAJOR1	6	6	I	-	
35	MINOR1	6	6	I	-	
41	MINOR2	6	6	I	-	
47	MINOR3	6	6	I	-	
53	HUC	8	8	I	-	

61	SEG	4	4	I	-
65	RMI	5	5	N	2
70	FEAT_NAME	60	60	C	-
130	FEAT_SRC	2	2	I	-
132	STATE	4	4	C	-
136	STATE-2	4	4	C	-
140	COUNTY	15	15	C	-
154	COUNTY-2	15	15	C	-
170	QUAD100	26	26	C	-
196	QUAD100-2	26	26	C	-
222	QUAD75	25	25	C	-
247	QUAD75-2	25	25	C	-
272	CEN	4	5	B	-
276	CUMLENGTH	4	12	F	2
280	DNARC	4	5	B	-
284	PNTR#	4	5	B	-
288	SAVENEG	1	1	I	-
289	SINUOUS	5	5	N	2
294	UHUC1	8	8	I	-
302	UPNTR1	5	5	I	-
307	UHUC2	8	8	I	-
315	UPNTR2	5	5	I	-
320	UHUC3	8	8	I	-
328	UPNTR3	5	5	I	-
333	UFLAG	1	1	I	-
334	DHUC	8	8	I	-
342	DPNTR	5	5	I	-
347	CSEG	3	3	I	-
350	CRMI	5	5	N	2
355	CNAME	30	30	C	-
385	RRN	17	17	C	-
402	LLID	13	13	C	-
415	OW_NAME	60	60	C	-
475	PRIMARY	6	6	I	-
481	SECONDARY	6	6	I	-
487	DESCRIPTOR	6	6	I	-

Datafile name: BANKS-PNW.PAT
8 ITEMS: STARTING IN POSITION 1

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	AREA	4	12	F	3	
5	PERIMETER	4	12	F	3	
9	BANKS-PNW#	4	5	B	-	
13	BANKS-PNW-ID	4	5	B	-	
17	MAJOR1	6	6	I	-	
23	MINOR1	6	6	I	-	
29	MINOR2	6	6	I	-	
35	MINOR3	6	6	I	-	
40	HUC	8	8	I	-	

Datafile name: BANKS-PNW.AAT
11 ITEMS: STARTING IN POSITION 1

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	FNODE#	4	5	B	-	
5	TNODE#	4	5	B	-	
9	LPOLY#	4	5	B	-	
13	RPOLY#	4	5	B	-	
17	LENGTH	4	12	F	3	
21	BANKS-PNW#	4	5	B	-	
25	BANKS-PNW-ID	4	5	B	-	

29	MAJOR1	6	6	I	-
35	MINOR1	6	6	I	-
41	MINOR2	6	6	I	-
47	MINOR3	6	6	I	-

Datafile name: STR-CNTRS.PAT
15 ITEMS: STARTING IN POSITION 1

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALTERNATE NAME
1	AREA	4	12	F	3	
5	PERIMETER	4	12	F	3	
9	STR-CNTRS#	4	5	B	-	
13	STR-CNTRS-ID	4	5	B	-	
17	NODE#	4	5	B	-	
21	CAPACITY	4	12	F	2	
25	IMPED-LIMIT	4	12	F	2	
29	IMPED-DELAY	4	12	F	2	
33	LINE-SYMBOL	4	5	B	-	
37	MAXIMUM-IMPED	4	12	F	2	
41	AVERAGE-IMPED	4	12	F	2	
45	ARCS-ALLOCATED	4	5	B	-	
49	UTILIZED	4	12	F	2	
53	ALLOCATED	4	12	F	2	
57	POINT-SYMBOL	4	5	B	-	

* Note: Items are NETWORK:ALLOCATION default, units are in meters

Map projection parameters for PNW Reach Files:

PROJECTION ALBERS EQUAL AREA
UNITS METERS

1st lat	43	30	00
2nd lat	47	30	00
cm	-114	00	00
lat org	41	45	00
easting		0.0	
northing		0.0	