
Questions Concerning Porting of StreamNet Spatial Data to the USGS/EPA National Hydrographic Dataset:

Objective 4 of the StreamNet Fiscal Year 1998 Workplan

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Background: During 1996 and early 1997 I assisted in the composition of a White Paper on the adoption of the National Hydrographic Dataset (NHD) by StreamNet and on data transfer between stream layers of different scales. At that time I was in favor of the transfer of StreamNet to NHD, particularly after attending a meeting on the subject hosted by Bruce Fisher of the USGS WRD in Portland during May, 1996. But concerns over such a transfer to the NHD have surfaced since then, both because of database design and mounting development problems with NHD and the Visual Pass tools used for correcting errors within it.

My original impression was that there would be significant enhancement in stream density over the current PNW reach system. In Washington State at least that will not be the case and probably not in the other three states either. Another impression was that the NHD would fall well within the design standards of the PNW reach system, thus, making such a transfer as painless as possible. But the published design of NHD carries very little reflection of the PNW system, other than the addition of center lines through double banked streams and water bodies. These impressions more than likely stem more from a misconception on my part during the May, 1996, meeting and are not to be implied as a misrepresentation of NHD by those involved with development. Their task has been great and the effort to meet many the use requirements has been trying to say the least.

These concerns are based on my five years experience with the 1:100,000 scale PNW reach system at WDFW, how the NHD design would impact WDFW from a GIS perspective, and the potential fallout if the transfer requires a significantly greater amount of work than currently anticipated. During late 1992 a one year project to correct and enhance the current PNW reach system was planned and funded by BPA. The reality was that one year rapidly turned into two, and in many instances, a good share of three, at least here in Washington State. Only in late 1994 did the new system become a reality and was then installed during 1995 and used as a base layer for mapping. The route system was subsequently added during winter of 1996. My recommendation at the end this paper is to strike the planned transfer from this and

future workplans until StreamNet has a much better scope on what to expect from the NHD after it become available. The recommendation is to replace the transfer task with one on experimentation with a CU or two from each state, then seek outside Federal funds other than BPA to finance the transfer to NHD. This approach would provide a much better time and funding expectation rather than having to keep requesting more funds from BPA as we did during the recent PNW project.

In my opinion, to be "National" is important but offers no substantive advantage to StreamNet or BPA at this early date. Funding from EPA and other Federal agencies has not been that forthcoming in recent years and to use the transfer to NHD as a data carrot/stick is not worth the risk. StreamNet has a good reach system now that has proven track record of six years at WDFW. I strongly recommend that StreamNet use the existing PNW reach system until NHD has a proven track record.

Introduction: Objective 4 of the *StreamNet Fiscal Year 1998 Work Plan* considers the transfer of the Streams route system and StreamNet GIS data to the National Hydrographic Dataset, an effort to meet National Standards for the 1:100,000 reach system. Objective 1 designates completion of updates for key species of resident fish, primarily the Dolly Varden/Bull Trout and the three Cutthroat species.

At WDFW there are four points of concern with the planned transfer to NHD. These concerns are: (1) the significant number of 24K streams that will be lost from the Washington State Catalogue Units; (2) the integration of polygon features with line work in the NHD; (3) the unknown amount of time that will be required to transfer the route system and StreamNet data to this unproven reach system, along with the work required to complete the updates mentioned in Objective 1; and (4) the potential political and financial fallout if the transfer goes sour, requiring more expenditures and time than estimated, or the question of who will pay in the end?

The questions that need to be answered are: will the loss of streams and the work and risk involved in this transfer be worth the effort to WDFW and StreamNet in general? Would not the required expenditure of BPA resources slated for making the transfer be better directed toward continued updates to the present reach system which, in Washington State at least, is a superior product? This is not concerning EPA funding for the Visual Pass, but only for the unknown expenditure of resources that will be required after the Visual Pass has been completed.

Each individual concern at WDFW will be expanded upon and explained why it also

should be of concern to StreamNet. Past experience from previous correction and enhancement efforts funded by BPA would strongly suggest that several unforeseen problems will be encountered, regardless of how complete the Visual Pass (VP) procedures appear to be on the surface. One might say it is the highly unpredictable nature of GIS database compilation and planning, a fact that is readily verified by reviewing the past 18 months of NHD and VP development. Following is Objective 4 as currently stated in the Workplan:

Objective 4 - River Reach System / Hydrologic Referencing: Create and maintain the means to link StreamNet data to hydrologic units, streams, and specific locations and to analyze and display this information using database and geographic information system technologies. Work on the 1:100,000-scale river reach system will be undertaken in collaboration with the USGS/EPA National Hydrographic Dataset project and will meet national standards.

Note: Fulfillment of the following tasks will require funding beyond the current Fish and Wildlife Program contract. Funding from outside of the Fish and Wildlife Program will be sought to assist in full implementation of these tasks. The Fish and Wildlife Program budget will fund between .2 to .4 FTE in each of the four states to participate in the completion of these tasks. Outside funding, if secured, will be used to fund overall coordination and possibly additional work at the state level. Guidance for this will be provided by a white paper on the subject completed during FY 1997. Completion of these tasks assumes timely completion of the NHD and that the final product meets advertised specifications. Integration of the 1:100,000-scale hydrography into the StreamNet system will proceed regardless of progress on the NHD.

Task 4.1: Maintain active coordination with the National Hydrographic Dataset team, providing comments and technical assistance as necessary.

Product: Activities summarized in quarterly and final reports.

Task 4.2: Review the National Hydrographic Dataset product in terms of its treatment of lakes and reservoirs. As necessary, establish graphic links and provide regionally consistent unique numbers for stream-linked water bodies. Prepare a recommendation regarding if and how high mountain lakes should be integrated into the system.

Products: 1) Lakes and reservoirs in system; 2) High lakes recommendation.

Task 4.3: Make preliminary corrections to the National Hydrographic Dataset product.

Product: Corrected graphic files.

Task 4.4: Implement the river reach system maintenance strategy described in the FY 97 white paper on this subject upon successful completion of the NHD. Steps may include:

- a. Establish regionally consistent maintenance and enhancement protocol and procedures.
- b. Aggregate route and ID coverages into one library.
- c. In accordance with protocol, assign names to unnamed streams, create routes, and add unique stream ID. (Protocol will establish the type and extent of unnamed streams to be included).

Products: 1) Brief report describing protocol and procedures; 2) 1:100,000-scale hydrography modified as per protocol.

Task 4.5: Port applicable StreamNet data to the new 1:100,000-scale hydrography.

Product: Progress summarized in data holdings report.

Task 4.6: To the extent resources will allow, provide technical assistance regarding use of the 1,000,000-scale river reach system to others involved in the Fish and Wildlife Program and activities that support Program goals and objectives. These services may include providing access to data via the Internet, providing AMLs and methods for using routed coverages, integrating the event tables, etc.

Product: Activities described in quarterly and final reports.

Questions of Concern: Past experience with GIS project planning indicates a strong statistical bias toward underestimating the time required to complete a project, as illustrated by the enhancement project on the PNW files during 1993 - 1994 and the present NHD project. At WDFW I have used the standard practice of building a time estimate and then doubling it. Seems to work quite well, sometimes. In the case of the transfer to NHD little or nothing is known on which to base an estimate for time or resources; and for this reason the following questions are of significant concern at WDFW and should be as well at StreamNet.

1. Loss of streams: The replacement of lost streams is not addressed by the Workplan but is of direct concern to WDFW. Only a few of these streams may have data

attached but all the added streams will figure into the transfer of the route system to the new layer, thus, creating potential problems in rebuilding the route system.

During the 1993-94 PNW 1:100,000 scale reach system enhancement project a significant number of streams were added to the Washington Catalogue Units. The majority of these streams were added to normalize stream density across the 100K quads. It was often the case that streams which appeared to terminate at the edge of a quad continued on into the adjoining quad at the 1:24,000 scale. These streams were added from 24K sources to complete the layer for addition of routes and to provide more coverage for anadromous and resident fish distribution.

The question concerning these streams was asked of a representative from RTI and the response was that only connectors, if any, were added for such streams and that on-ground representation would not have been maintained. In a word the NHD would remain at the present density and any added streams from outside sources will be lost, thus, resulting in an inferior layer in Washington State. It is not sure what was meant by "connector" arcs but if past EPA designs are a predictor of NHD, the reality is that a straight line is simply drawn from these hanging streams to where it is thought they might connect into the downstream channel. This is unacceptable for the transfer of data between layers, either from the current 1:100,000 PNW reach system or for planned 1:24,000 projects, such as that currently envisioned for Washington State (See Appendix I).

The literature on the Visual Pass Project that was brought back from the training sessions in Denver clearly states that the new system as a final EPA product was not intended nor designed for GIS database management and mapping as normally done at present time, but more of a simple graphic representation of rivers and streams at the 1:100,000 scale with extensive attributing based on an object oriented design of integrated line work and polygons, which leads to the next concern.

2. *The integration of polygon features with the stream network:* The current understanding is that the polygon features are integrated with the stream network in an object oriented approach and that topology was built as lines only. Bill Wettengel of the Olympic National Forest stated that the impression he had was that this design may have been chosen because of the Spatial Database Engine (SDE) developed by ESRI during the past couple of years or so. His statement also was that the USFS would not be acquiring SDE in the near future due to the expense, as will probably be the case

with a majority of Washington State Agencies except, perhaps, DNR.

This SDE design assumption has not been confirmed but processing of such a massive National database at a regional scale using SDE would make a lot of sense to EPA and other regional Federal agencies. But regardless of the design intent, this structure is not compatible with present GIS practices at WDFW where built polygonal features are required for shading of water bodies for mapping and for present and planned data management. Unless the other three StreamNet fish and wildlife agencies have made significant advances in software purchases from ESRI, such as SDE, it is assumed that mapping practices would be similar to those presently done at WDFW.

If polygon topology was built on the layer as it is, each water body with center lines would have two or more polygons representing one feature, an unacceptable situation for building and referencing a high alpine lakes database as planned at WDFW. Perhaps in the attribute tables there are references that would tie the polygons as one object but such complexity has not proven its worth with the Washington DNR layer which also is an integrated line and polygon layer. And primarily due to financial constraints and processing limitation, WDFW is one of the state agencies that will not be acquiring such modules as the SDE or Map Objects in the foreseeable future.

To use this layer for mapping and for building of the high alpine lakes database at WDFW the polygonal features would have to be dumped to a separate banks layer and built as polygons, as the present PNW reach system is. The Washington DNR has its 1:24,000 scale layer built both as polygons and lines in a township format. Whenever re-tiled for use at this agency or the at USFS for basin level route construction, the polygon features have been dumped to a separate layer to facilitate management and routing. This is not to say that it cannot be used as a combined layer just that it has not been practical to do so because of multiple polygons that represent one feature, especially within large lakes and double banked streams. Since DNR does not route or attach data to their system it works quite well in Forest Practices, based on the Water Types which are hard coded into the layer.

3. *Rebuilding of the Streams route system and data transfer:* In Washington State all but twelve of the seventy Catalogue Units contain anadromous fish distribution. The number of Catalogue Units that will involve Cutthroat and Bull Trout updates is probably about the same. During the building of the recent anadromous data sets several errors were discovered in the route system. These were a result of streams that

have the same name and or were missing names for small "hard-to-see" un-named reaches of a few feet or more.

Other problems have been very short connector lines that were not tagged with the stream name or that were not tagged during the building of routes on streams without names, thus, creating very short routes with LLIDs all of their own. An effort was made to correct these problems before the addition of routes but it has become obvious that several had slipped by. From a recent e-mail from Duane Anderson it is obvious that several more errors still exist.. It is probably safe to assume that several more errors still exist beyond these.

Discussion: So the questions concerning NHD on this subject are: how error free will the new system be despite the best efforts of Visual Pass? How error free is the transfer of the LLID to the new National Hydrographic Dataset? Or are the LLIDs being transferred at all? Is the intent that in the PNW we are to transfer the LLID based on some relate variable tied back to the existing system? (If the LLID has already been transferred, so were the errors that were in the present PNW route system before corrections at WDFW and at other states took place.)

Building of the route system statewide has proven to have been a lot of work; and correcting inherent errors in both the reach system topology and routes has been an additional unpleasant and seemingly never ending task. Experience has shown that the building of route systems provided a great tool for finding errors in the PNW reach system topology and that the automated building of event tables provided an equally effective tool for finding additional errors in the route system, but only where data were tied to the route system.

After reading the very frequent and usually copious e-mails from the Visual Pass development group, accuracy and error free does not exactly seem promising nor does the continued problems give a lot of confidence in the final product. It would seem they are having to deal with the near infinite realities that the four NED states faced with the corrections on the present reach system. According to RTI the "homework" quad assigned to Washington State is not even available yet. So where does the processing the greater whole of the PNW stand as of this date?

Another question on this is how many versions of the tools will be required to get it right? Once a quad is complete, or thought to been completed with an earlier version of the tools, will another Visual Pass of that same quad be required to correct the

additional problems that were missed using previous version. In addition, how many times will this cycle have to be repeated after all the bugs are finally out of the tools? What about edge matching to rebuild the CU tile structure, a necessity for networking within a basin? It is promised that edge matching will be complete after the Visual Pass, but these problems were still inherent with the PNW system up and until the recent correction and enhancement project.

So after all is done and complete with Visual Pass will the reach system even be right after the Visual Pass has been refined or will more hidden errors be introduced because of it? This is not meant to be critical but based on the reality of past experience. And only with the building of a route system and subsequent addition of data will these questions of NHD be answered.

So where does this lead to? These questions or concerns at WDFW raises the macro question that hinges upon all the previous: is it wise to pin the future of StreamNet spatial data sets during these financially strapped times on a system that has no proven track record of any kind? Should StreamNet be considering such a massive transfer when the Project presently has a well thought out \$1,000,000 reach system that has been proven to work and took several years to develop? And should StreamNet be contemplating this type of large unknown when there is the much more important regional need of entering additional and updated information to existing Project databases?

This is not to say that StreamNet should not be involved in the Visual Pass. It is a valuable source of finances and will be a good learning experience into future graphic database structures. But only to ask should StreamNet try to incorporate the product immediately once it has been completed? Because of the agreement with EPA to complete the Visual Pass for the Pacific Northwest, this does not necessarily mean that there is an obligation to use the NHD at this time. At least there should not have been an agreement as such.

The risk of using an unproven dataset raises another concern, what about BPA if the transfer road turns rather rocky? BPA with its newly found business attitude brought on by the deregulation of electrical power combined with dwindling Federal subsidies is not the same agency today that support the NED and CIS projects over the past several years. BPA could very easily grow weary of constant delays and continued expense should they happen with this transfer. And does BPA really care if the

StreamNet Project is National at the GIS level at this time, or ever? Does the agency really care what goes on in Alaska or California concerning salmon or other anadromous fish species? Or would the agency be more interested in a sound and working database for their region of influence, such as the present PNW reach system currently provides for the agency today?

The concept of "National" has a nice sounding ring to it and will be more important as time passes, especially if California and Alaska join our noble effort. But does the concept really matter at this time to a still struggling to prove its worth, single source dependent project such as StreamNet? Despite wishful thinking and the best of intentions to seek outside funding or support, the reality is that without the BPA Fish and Wildlife funding there would not be a StreamNet Project. So this financial aspect should be considered quite seriously.

A recommendation from up North: Put the planned transfer to this National Hydrographic Dataset on hold and drop it from the 1998 Workplan. Instead, add a task to the 1998 Workplan to experiment first with NHD before planning a full scale transfer to this new, yet unproven or even existing, National Hydrographic Dataset. With the on-going problems it will probably not be ready for distribution until spring of 1998 or possibly early 1999 anyway.

After the Visual Pass is complete it is recommended that a CU from each state be chosen to get a realistic estimate on how much work is really involved in rebuilding the routes and transferring StreamNet data to the new dataset. This work could be completed at PSMFC. This would also bring the added extra bonus of building a long needed consistency into the regional database and, thus, making easier to force the states to comply. If the results show that it is feasible, both technically and financially, write the task in a future workplan, dependent upon additional funding from the EPA or other Federal agencies to complete the task since the transfer is probably is not a priority to BPA anyway. To undertake this task based on a hope that it will pay off in future funding from EPA or other Federal agencies is too risky and such assumptions have proven empty in the recent and distant past.

Appendix I: Washington State and 1:24,000 Scale Hydrography

At this time in Washington State there is still, yet, another new initiative to develop a statewide 1:24,000 scale stream layer ("Framework"). To this date four Washington Resource Inventory Areas (WRIA) have been completed as a test in and around King County. The layer is complete with routes and the IRICC LLID transferred from the present PNW reach system. This project was recently completed by Washington Department of Ecology. (A WRIA is roughly equivalent or in many cases larger in size than a CU. There are 62 WRIA and 70 CU in Washington State.)

Indications are that this test has been a success. Part of this success rests on the thinning of the ultra dense DNR 24K layer down to a manageable density, a major step back from the original WASWIS plan. The said basis for doing so rested upon the impression that much of the densified part of the DNR layer was entered via photogrammetry and is, thus, too subjective to be entered into a permanent routed database. Additional streams would be added in the future only if verified as being real streams and not ridge tops or old logging roads. A two year estimate of completion has been tossed about in management circles. Since WDOE completed the four WRIA in one of the most difficult areas of the state their time estimate is probably quite sound, hence, a strong hint that StreamNet should do a little testing of NHD before leaping into this big unknown project.

WDFW is seriously considering joining this latest initiative. The usual argument in this and other state and federal agencies prevails: the 100K just does not provide the coverage required for certain detailed data collection and analysis efforts. On this need I am not in a position to agree or disagree, only that I now agree that this latest plan is quite workable as it presently stands. If the project does become a reality it would be good test for the assumptions of data transfer between scales that were discussed in that White Paper. And if it does become a reality, this new 24K database could be a valuable source for additional information from several other Washington state agencies that could be integrated into StreamNet.