
# Transfer of River Resource Information Between GIS Layers with Different Scales

## - Project White Paper -

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**Title:** Transfer of River Resource Information Between GIS Layers with Different Scales

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## Task Description

Task 4.8 Establish protocol for linking data collected at other scales to the 100K StreamNet system.

Products: Draft (November 30) and final (January 31) protocol.

## Background

As rivers resource data collection efforts by local and regional agencies intensify within the Pacific Northwest, there is a growing need for these agencies to share this information. Data sharing would assist in conserving increasingly scarce financial and human resources plus solidify cooperative efforts to preserve and restore our valuable anadromous and resident fish populations.

At present time river and stream GIS data are primarily compiled at the 1:100,000 (100K) and 1:24,000 (24K) scales. Tribes and Federal district offices of the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) tend to collect data at the 24K, while statewide and regional efforts (including StreamNet) are compiled at the 100K. The 100K is currently undergoing significant enhancement through the National Hydrographic Dataset (NHD) project. The principal objective of NHD is to connect the 100K with a nationally standard version of the EPA river reach referencing system. The resultant system will provide significant advantages for future aquatic data development efforts.

StreamNet is an active participant in this process and will likely be involved in managing the resultant product. Current plans call for StreamNet to conduct a thorough review ("visual pass") of the NHD product starting in late spring 1997 and to have the system operational by fall 1997. Due to the scope of the effort, no similar effort is planned for the 24K system. It is unlikely that this will occur in the foreseeable future. Further, and again due to the scope of the effort, other enhancements to the 24K are certain to lag far behind the 100K.

The 100K is acknowledged to be the appropriate scale for regional uses such as the NPPC Fish and Wildlife Program due to its regional standardization, its technical manageability, the availability of data, and its usefulness for regional policy, planning, and management

activities. (Evaluations have shown, for example, that the 100K covers the vast majority of the streams known to contain salmonids. While there are certain to be additional headwater streams capable of providing spawning habitat, little is known about these except in areas subjected to intensive monitoring.) At the same time, the 24K is an excellent scale for the more site-specific data activities that are typical of forest management and local planning. Both scales have advantages for watershed planning activities, depending on the size of the watershed and project objectives. While StreamNet will continue to use the 100K as the key building block of its data system, there are significant advantages to having a process for merging 100K and 24K information, both in terms of acquiring information from more localized sources, and servicing the needs of these same cooperators.

Through the interagency IRICC process an effort is underway to establish data standards for both fisheries and hydrologic data. To that end a data standards paper has been produced by the IRICC Fish/Hydro team. The standards recommended in that paper will contribute considerably to the establishment of a process for moving data between the 100K and 24K scales.

At present time the only known Pacific Northwest attempt to merge 24K and 100K information is the WASWIS project undertaken by the Washington Department of Ecology (WDE). Little information on methodology, success or failure, or implementation strategy has been made public. WDE literature primarily describes planned capabilities, not methodology. Available descriptions indicate that a reach matching procedure would be used to transfer information between the Washington Department of Resources (DNR) 24K layer and the 100K layer that has been in use by WDFW for the past several years.

## Issues

There are three major issues of concern when considering data transfer from one scale to another: 1) maintaining data accuracy during the transfer, 2) rectifying differences in linear and location measures between scales, and 3) the relative efficiency of completing a transfer. These are discussed below.

1. Maintaining Accuracy. If the methodology and procedures described at the end of this document are used, data accuracy will be maintained at an acceptable level (see Recommended Procedures). Briefly, this procedure would involve converting linear data (i.e. fish presence or known spawning locations) and location specific data (i.e. blockages to anadromous fish and/or dams) stored in Arc/Info dynamic segmentation event tables to GIS point layers. The points would then be used to regenerate the event tables at the new scale. All attribute information and measures in the event table could be transferred and software could be developed to complete the task with relative ease.

   In moving between the two scales, it is critical that data be transferred to the correct

streams. Significant differences can exist between 24K and 100K layers describing the same river or stream system, particularly for headwater reaches and in-stream density. Generally, a 24K layer will include a significantly larger number of headwater reaches than are in a 100K layer and up to 50 percent more streams. This is providing that a comparison is made with the number of streams in a USGS. 7.5 minute quad map, not a densified layer. A densified layer is one which additional streams have been added to those displayed on a USGS 7.5 minute quad map.

Another factor contributing to the problem is that 100K at the smaller scale is more generalized while the 24K is more detailed, often resulting in noticeable difference in the line work representing a given stream. These factors could cause data to be transferred to the wrong stream or to no stream using the point transfer method. However, with today's technology and proper procedures this problem can be remedied.

2. Rectifying Linear and Location Measures. The greater detail in 24K line work results in significantly larger distances or measures at a given spatial coordinate at the same location on a stream than at 100K. This difference is due to generalization of the line work at 100K, i.e., fewer stream meanders or lower sinuosity over a straight line distance. This will cause a significant difference in the length of linear events and the location measure of a point event. These measures will be up to 75 percent larger at 24K, depending upon type of terrain and the date of compilation of the source maps.

3. Convenience of Making a Transfer. For data transfer to be realistic and cost effective the procedures must be capable of being automated while maintaining accuracy. To realize this, the IRICC standards must be used and databases at both scales must be consistent with standard core variables. At present time the standards are being implemented at the 24K scale in a test case by the BLM and USFS with technical assistance provided by the Washington Department of Wildlife (WDFW) and the Olympic National Forest. If successful, this model will be the impetus for the start of a regional 24K database. For data sharing between scales to become a reality, these standards with core variables describing route systems, event tables and structure must be developed and implemented for the regional 100K.

## Recommendation

As suggested above, the key condition for success is adherence to IRICC standards and implementation of consistent data structures at both scales. It is recommended that StreamNet and other cooperators adopt specific scale transfer procedures with a custom software package prepared to facilitate use of these procedures. If adopted, these procedures would solve the potential problems concerning the transfer of data tables between scales. The proposed procedures would be both user friendly and reliable. The components of this strategy are outlined below.

1. Event Information. Data stored in linear event tables would be converted to

temporary GIS point layers defining the beginning and ending measures of the event or events on each stream. Relevant attribute information including beginning and ending measures would then be transferred to the GIS point layer. The event tables would then be regenerated at the new scale using the points. To complete the process, the attribute information including measures would be transferred from the source layer to the new table. A similar approach would be used for point or location specific data.

2. Maintaining Data Accuracy. Two options are available for preventing data from being transferred to the wrong streams. The first would use a "visual pass" approach where the point layer generated from an event table would be displayed over target stream layer. Points that are not on or near the correct stream could be moved to the proper location. An alternative would be to develop a "programmed stream ID matching" routine that would select the proper stream by ID then make a transfer stream by stream. This approach might have limitations when transferring 24K data to 100K but would be quite reliable for 100K to 24K. (The weakness in 24K to 100K transfer is a result of the lower stream density and fewer headwater reaches at the 100K.) Tests could be conducted to develop a reliability factor for both methodologies. It is recommended that both options be explored, with a preferred option selected through that process.

3. Rectifying Linear and Location Measures. The spatial coordinates of the end points of linear and point events will remain constant regardless of scale. This is the basis for using point based procedures to transfer data between scales. The rectification of measures between scales would involve a transfer of 24K measures and distances to 100K layers, not a real conversion. The concept is to transfer 24K measures to 100K. This would be a more realistic strategy for completing analyses than 100K measures because of the fore-mentioned reasons. However, due to the slow development of a regional 24K database several years may pass before higher scale measures could be used. This concept is, therefore, more for future planning than present use.

It is proposed that the data structures described above be developed through the StreamNet project and in consultation with the IRICC. Technical implementation would be by WDFW in cooperation with the Olympic National Forest Office in Olympia, WA. Data structures would be in the form of a transportable software package with install routines provided. This package would include procedures for both linear (i.e. fish presence and spawning) and point location (i.e. blockages and dams) information. Tools and safeguards to insure data accuracy and measure conversion between scales would be included.

## Rationale

The justification for developing procedures and a software package for transferring information between scales is based on the potential data collection savings and the cooperation that may result between local and regional agencies in planning restoration projects. Also, it is highly probable that data collected at the 24K scale will be of higher

detail than that which is currently being collected at the 100K. If the capability to transfer data is implemented the regional StreamNet information would likely be used as a base for higher scale data collection efforts. Once completed, the updated and/or more detailed information could be entered into StreamNet.

A second benefit would be the potential for enhancement of the 100K layer. Streams at the 24K level which have data but are not presently in the 100K layer could be added to the layer, thus, providing a continuous and systematic upgrade of the 100K layer without having to manage the high density of a 24K layer. These additional streams would already have an IRICC stream ID and associated route system, further saving development costs. Procedures and software could be developed to complete this task, insuring continued standardization of the regional database. The end result would be a scale-independent system that has the advantages of both the 100K and the 24K layers while minimizing their inherent weaknesses.

As suggested above, WDFW and the Olympic National Forest are currently cooperating on the 24K-100K issue and have gained considerable experience in this field. This plus their institutional association with both StreamNet and IRICC make them the appropriate entities to undertake this development.