SAMPLE & ANALYSIS PLAN

Water Quality Monitoring: North Fork John Day Sediment Assessment

DEQ08-LAB-####-SAP- Sedimentation
Version 1.0 – August 1, 2008

Group A: Project Management

A1. Title and Approval Sheet

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A3. Distribution List

The following is a list of all the individuals and their organizations who will receive a copy of the plan.

Name	Organization	Telephone
Don Butcher	Oregon Department of Environmental Quality (ODEQ)	(541) 278-4603
Rosy Mazaika	Bureau of Land Management (BLM)	(503) 808-6076
Anna Smith	Bureau of Land Management	(541) 416-6747
Trish Carroll	United States Forest Service (USFS)	(503) 808-2905
Caty Clifton	United States Forest Service	(541) 278-3822
Doug Drake	Oregon Department of Environmental Quality (ODEQ)	(503) 229-5350
Larry Marxer	Oregon Department of Environmental Quality	(503) 229-5983
Jim Webster	Confederated Tribes of the Umatilla Indian Reservation (CTUIR)	(541) 276-4348
Amy Charette	North Fork John Day Watershed Council	(541) 421-3018
John Faustini	Environmental Protection Agency (EPA)	(541) 754-4581

A4. Project/Task Organization

The following lists the individuals or organizations that will be leaders in the project.

Name	Project Title/Responsibility	Contact
Rosy Mazaika	Project Manager	(503) 808-6076
Don Butcher	ODEQ Project Lead	(541) 278-4603
Caty Clifton	USFS Project Lead	(541) 278-3822
Demeter Design	Data Manager, QA	(503) 368-7195
ODEQ Lab	Data Manager, QA	(503) 229-5983

A5. Purpose Statement/Problem Definition/Background

The purpose of this project is to acquire baseline data to (1) develop and apply appropriate protocols and metrics to evaluate ecological impairment due to streambed particle size, and (2) re-evaluate the current listings and surrounding landscape, and (3) begin development (if needed) of a TMDL for sedimentation in the North Fork John Day Basin, Oregon. Nine creeks entailing roughly 79 miles are listed for sedimentation based on "The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry" per OAR 340-041-0285(2)(J). These streams are considered impaired under Section 303(d) of the Clean Water Act for sedimentation. As a result, ODEQ is required to develop a TMDL for these listed streams. The name, mileage, watershed, and basis for each listing are shown in table A5-1.

Through discussion with ODEQ staff, North Fork John Day Basin partners and professional advisors on aquatic habitat, the use of the EPA's EMAP protocol was deemed the most appropriate to meet the project goals stated above. Data collected using the EMAP protocol results in a number of key metrics used to evaluate impairment by sedimentation using a "weight of evidence" approach. Key indicators of sedimentation are Relative Bed Stability (RBS) and the percentage of sands and fines (%SAFN). Additional indicators include woody debris volume and abundance, bank stability, pool volume, width to depth ratio, and embeddedness.

Among the goals of this program is to continue development of a meaningful protocol and criterion for evaluating impairment due to sedimentation in the State of Oregon. The high variance and overlapping ranges of natural and anthropogenic sediment loading and particle size presents the need to ensure a sampling methodology and assessment that accurately reflects whether the sediment load in the streams measured exceeds the natural capacity of the stream to generate, transport, and accumulate sediment. This determination is made by comparison to ecoregion specific data gathered from reference watersheds. Reference watersheds are identified based on minimal anthropogenic disturbance.

DEQ Laboratory staff, USFS, EPA, and ODFW have identified numerous reference sites and have used a number of different habitat assessment protocols to characterize these reference sites. The DEQ has undertaken the development of numerical sediment criteria using EMAP as the primary foundation for listing and delisting based on instream sedimentation. Additionally, relevant data collected using alternative protocols is suitable for consideration under the "weight of evidence" approach.

An additional evaluative tool will be GIS analysis of land use. Significant analysis of the relationship between land use and sedimentation has been completed by the EPA research lab staff, and will be integrated into the results of this assessment.

TABLE A5-1: Mid Coast Streams Water-Quality Limited per 303(d) List for Sedimentation.

Creek	Mile	Watershed	Supporting Data
Alder Creek	0 to 5.5	Big Wall	Steelhead redds have shown declining trends over past few years, cobble embeddedness did not meet PACFISH objectives (Wall Ecosystem Analysis, 1995).
Big Wall Creek	0 to 21.3	Big Wall	Steelhead redds have shown declining trends over past few years, cobble embeddedness did not meet PACFISH objectives (Wall Ecosystem Analysis, 1995).

Hog Creek	0 to 4.1	Big Wall	Steelhead redds have shown declining trends over past few years, cobble embeddedness did not meet PACFISH objectives (Wall Ecosystem Analysis, 1995).
Porter Creek	0 to 7.4	Big Wall	Steelhead redds have shown declining trends over past few years, cobble embeddedness did not meet PACFISH objectives (Wall Ecosystem Analysis, 1995).
Swale Creek	0 to 11.1	Big Wall	Steelhead redds have shown declining trends over past few years, cobble embeddedness did not meet PACFISH objectives (Wall Ecosystem Analysis, 1995).
Wilson Creek	0 to 10.7	Big Wall	Steelhead redds have shown declining trends over past few years, cobble embeddedness did not meet PACFISH objectives (Wall Ecosystem Analysis, 1995).
Bull Run Creek	0 to 9.3	Granite	USFS Data shows large changes in erosion hazard between natural and current conditions. Degradation of stream habitat has reduced the potential for supporting fish. (Granite Watershed Analysis)
Granite Creek	11.2 to 16.2	Granite	USFS Data shows large changes in erosion hazard between natural and current conditions. Degradation of stream habitat has reduced the potential for supporting fish. (Granite Watershed Analysis 1997)
Baldy Creek	0 to 5	Upper North Fork John Day	USFS Data shows large changes in erosion hazard between natural and current conditions. (Upper North Fork John Day Watershed Analysis 1997)

A6. Project Task/Description

Overview

Site selection is based on protocols developed by the EPA to support EMAP surveys throughout the nation. Stratified random sampling will be used to characterize the condition of the listed stream reaches and upstream tributaries. A site map and table of site locations will be prepared prior to field survey work. Table B1-1 provides an overview of the sites to be determined. Sites will be ground-truthed for stream conditions and access issues and may be adjusted as necessary, including reducing the number of transects performed at sites where accessible reaches are short. At least one reach will be measured at each of the streams listed on Table A5-1.

All sites will be evaluated based on the approach used in sediment assessments of the Nestucca, Siuslaw, and Tillamook Bay by Demeter Design, BLM, and ODEQ (Mico & Mico 2007, Mico & Mico 2008). The field protocols can be found in the EMAP field manual (Peck et al 2001). In general, EMAP data is not sufficiently precise to

draw meaningful conclusions from single sites. The primary focus of the analysis will be to evaluate population and subpopulation characteristics. If the data indicate possible impairment but lack the statistical power to precisely characterize a subpopulation of interest, additional long term monitoring may be recommended. Where possible, evaluation of individually listed stream reaches will be conducted.

While developing this sampling plan, it became apparent that one of the listed stream reaches, Baldy Creek, was also considered a reference reach. The original 303d listing was based primarily on potential impacts of recent forest fires on soil erosion. The reference designation does not take fire into account, and is instead based upon GIS indicators of land use, and is finalized with a field verification. For this reason, Baldy was placed into both categories. For the purposes of this study, Baldy will initially be considered neither reference nor impaired. Field observations, instream data, and consultation with professional experts will be used to determine Baldy's appropriate status.

Site Selection:

Sites were selected from the "Master Sample" produced by the EPA research lab in Corvallis OR (see attachment). The "Master Sample" was developed in support of statewide efforts to coordinate monitoring efforts. It is a statewide panel of random sites drawn from the National Hydrography Database Plus (NHDPlus) using the General Random Tesselation Stratified (GRTS) algorithm (Stevens & Olsen 2004). It contains thousands of sites seeded at roughly 1 km intervals along the stream network. By utilizing a subsection of the Master Sample, the data collected in this study can now be easily integrated into regional assessments and future monitoring.

Sites were clipped from the statewide "Master Sample" using the Big Wall (HUC) and Granite (HUC) 5th field watersheds to generate the pool of non reference sites. Reference sites were identified by extracting all Master Sites within reference watershed boundaries provided by DEQ Laboratory Staff. All reference watersheds are within the Blue Mountain Level III Ecoregion. One data layer comprises the areas identified by DEQ as meeting reference standards. A second data layer comprises areas identified by Chuck Hawkins during the development of the DEQ's macro invertebrate stressor model.

It has been observed that 1st order streams on the NHD+ are generally 3rd or even 4th order based on the stream network defined using 1:24K hydro coverages. This should be considered when interpreting the results of the study. Sites will be re-weighted during analysis to account for all changes in the sample frame and study design. Field truthing will be conducted to identify portions of the stream network which are too deep to sample. Subsequent modifications will be made to the GIS layers identifying site locations.

Stratification of Sampling

A proposed breakdown of sites by geographic subpopulation is included below.

- Big Wall 5th Field - 40 sites
- Granite & Bull Run 6th Fields – 20 Sites
- Baldy – 5 Sites
- Additional NFJD Reference Sites – 5 Sites
- Blue Mountain Reference Sites Outside the NFJD – 20 Site

Sites were allocated in order to best satisfy the multiple objectives of this project with the finite resources available. As determination of impairment is dependent on accurate estimates of both target (i.e. listed) stream reaches and reference reaches, effort was balanced between the subpopulations. The geographic stratification used in this study will result in a potential doubling of the available reference data from ~30 sites to ~60 sites (assuming Baldy is ultimately determined to be reference0. The remaining 60 sites are located within the listed watersheds. They are distributed roughly proportionally to size, with consideration given to potential statistical power. Big Wall Watershed contains six of the listed stream reaches (including the mainstem) and is the largest of the listed watersheds. The relatively large number (40) of sites reflects these facts. Variance is expected to be greater within a larger geographic area, therefore accurate estimates of instream conditions require a larger

sample. Conversely, the Granite Creek listings are restricted to two sixth field subwatersheds. Twenty sites within just those watersheds are expected to provide a relatively detailed understanding of instream conditions. Likewise, 5 sites within Baldy will provide a similar level of accuracy. The small size of the listed stream reach makes it impossible to visit more sites within the subwatershed.

Geology was evaluated using the most current geology data layers (OGDC-4) obtained from DOGAMI following consultation with DOGAMI staff. The primary goal was to determine is stratification was necessary to account for gross differences in geology. All rock types were divided into erodible and resistant categories. Sedimentary and surficial types were classified as erodible, and all volcanic or plutonic rock types were classified as resistant. Some rock types, such as 'Mixed Terrane' could not be classified either way. Based on this analysis, stratification by geology was deemed unnecessary. Big Wall is almost completely resistant and Baldy is primarily erodible, obviating the need for stratification. In contrast, the geology of the Granite Creek sub watersheds is so complex that stratification by geology is essentially impossible. Additionally, field truthing of the dominant in channel substrate as either resistant or erodible will be conducted.

Preliminary field assessments completed to inform this SAP indicated that most if not all first order streams within the Big Wall may be dry. Even the mouth of Big Wall was found to flow subsurface when visited in early August. In order to best characterize the wetted stream network, sites will be stratified within Big Wall to emphasize second order and greater streams. First order stream reaches will be initially excluded from sampling. If subsequent investigation indicates that they may have significant flow, they may be added back into the sample.

Site Visitation Protocol

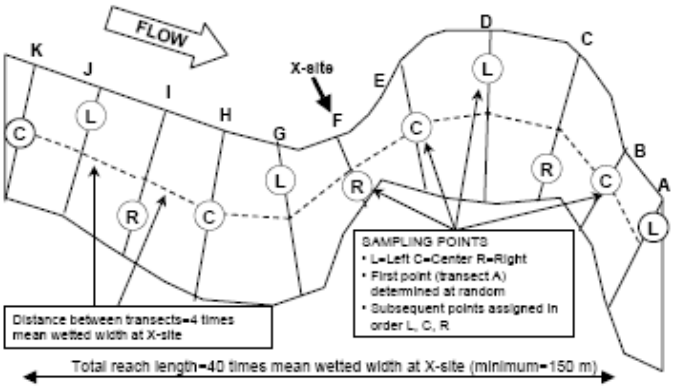
The overall objective for is to collect data from a total of 90 sites. 25 sites will be from reference reaches, 5 sites will be in the Baldy Creek drainage (within the 6th field HUC 170702020101), 40 sites will be in the Big Wall Watershed (1707020208), and 20 in the two sixth field HUCS (170702020201 & 170702020202) which encompass the listed stream reaches in the Granite Creek Watershed. ODEQ will collect 40 sites, Demeter Design will collect 50 sites. Demeter Design will be responsible for the identification of sites for sampling, and will provide GIS layers to ODEQ to develop site specific maps.

Modifications will be made to the sampling plan as needed to account for GIS data errors, denial of access, or potential changes to the overall study objectives. Where sites do not coincide with the field determined location of the stream channel (due to the resolution of the NHD+), the final location will be decided by following the natural downhill course of water to the observed channel. The modified location will be recorded in the field on a topographic map.

Field Protocols

This project entails gathering the field data required to complete the RBS calculations and additional parameters. The RBS calculation used is that described in Kaufman et al. 2008a. The field methodology used is that described in EMAP-Western Pilot Field Operations Manual for Wadeable Streams, Section 7 (Physical Habitat Characterization), Rev. 1, April 2001, by Kaufman et al.

Collection of EMAP Physical Habitat Characteristics requires access to a reach of stream 40 times the wetted width and wading 11 transects to collect depth and substrate characteristics. The onset of the low-flow season is the best opportunity to evaluate the stream condition for sedimentation. Some streams may require access by inflatable raft, particularly in deep pool areas and larger streams. Site access limitations may require a modified, limited reach and transect number.



Measurements collected will include:

- Bankfull width & height
- Thalweg depth profile
- Pebble count
- Slope
- Habitat units
- Large woody debris volume
- Bank condition
- Wetted width

Field personnel will also make visual observations of water clarity and accumulations of sediment in the studied reach, as well as general observations of land use and stream condition. Each site will be photodocumented.

Analysis

A 'weight of evidence' approach will be used to evaluate potential impairment by sedimentation. Under this approach, multiple datasets and reports will be evaluated. EMAP physical habitat data (both old and new) will provide the primary indicators of habitat condition and potential impairment. At a minimum, the following EMAP based metrics will be evaluated at a population and subpopulation scale:

- Relative Bed Stability (LRBS)
- Percentage of Sands and Fines
- Residual Pool Depth
- Large Woody Debris Volume
- Width to Depth Ratio

Additionally, field observations and measurements will be integrated to evaluate bank condition, riparian disturbance, embeddedness, and spawning gravel quality & quantity. Existing data collected using alternate protocols such as AQI or PIBO will be evaluated and integrated where possible. For example, all protocols provide estimates of percent sands and fines, and large woody debris volume. Past and present land use practices will be evaluated using existing GIS Datasets and local professional knowledge. In addition to evaluating potential impairment by sedimentation, the impact of other physical habitat parameters such pool volume on stream function will be evaluated and discussed. A primary goal of the analysis is to evaluate the impacts of sedimentation within the context of other limiting factors within the various test watersheds.

EMAP data within the "Test" (303d listed) populations will be compared to ODEQ gathered reference data within the Blue Mountain Level III Ecoregion. ODEQ staff has indicated that benchmarks for impairment should be based upon minimally disturbed reference sites within each Ecoregion Level III. Additionally, stratification of reference sites by geology will be evaluated for each population and subpopulation. The core logic will be to compare each population to a pool of reference sites with a similar geology. Practically, this entails classifying all reference and test data as erodible or resistant. If an evaluation of the reference data shows that erodibility does not impact any given metric, stratification may not be necessary. Descriptive statistics and a variety of statistical tests will be used to compare test populations to reference. This may include comparison of the cumulative distribution functions (CDFs), population means, quartiles, correlation, as well as skew and kurtosis. Bayesian analysis is another toolset which may be used.

Additional information sources which will be evaluated during analysis are road modeling conducted by USFS staff as a complement to this study and basin scale (i.e. North Fork John Day) analysis of current land use impacts on instream sedimentation by EPA research staff.

A report detailing the results and interpretation will be completed and submitted at the conclusion of this process. ODEQ, BLM, and USFS staff will have the opportunity to provide comments on a draft of the report. The final draft will then be completed by the Contractor.

A7. Measurement Quality Objectives

For all data and information collected and analyzed by field staff, all quality assurance/quality control (QA/QC) procedures outlined in the DEQ Laboratory Quality Assurance Manual (1998) and the DEQ Laboratory Watershed Assessment Section Mode of Operations Manual (MOMs, 2004) will be followed as applicable to the parameters described in this SAP.

The effects of measurement error on the data can be evaluated directly during the analysis phase using Monte Carlo modeling approach. Please refer to Sediment, Shade, and Complexity (Mico & Mico 2007) for an example of this approach. Resampling 10% of the sites may not return statistically meaningful results on QA/QC.

A8. Training Requirements and Certification

Field crews need to be trained on the equipment and methodology for EMAP Physical Habitat Characteristics, data form completion, and field instruments used. Crews will preferably be local contractors with backgrounds in survey methodologies.

A9. Documentation and Records

Section A9 of the QAPP for this project identifies documents and records to be retained by the DEQ. Additional requirements are as follows:

- As outlined in the DEQ Laboratory Field Sampling Reference Guide (1998), field staff will prepare field data sheets prior to field measurement events. All forms used for EMAP protocols are presented in EMAP-Western Pilot Field Operations Manual for Wadeable Streams, Section 7 (Physical Habitat Characterization), Rev. 1, April 2001.

- Most data will be taken using digital PDAs. When necessary, separate field data sheets (Rite in the Rain) will be maintained for each sampling event. Information recorded on data sheets is to include: Project name, data and time of sampling event, water body name, and site ID. Each field crew will maintain the original field data sheets in a safe location as required by their Quality Assurance documents or submit the original field data sheets to the Data Manager for storage. Data will be delivered to BLM, ODEQ, and USFS at the conclusion of the project.

- Correction to Documentation: All original data recorded in field notebooks, chain of custody records, and other forms will be written in waterproof ink. None of these documents will be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error in made on a document assigned to one individual, that individual will make corrections by crossing a single line through the error, entering the correct information and initialing the correction.

GROUP B: DATA GENERATION AND AQUISITION

B1. Sampling Process Design

Specific samples and field measurements to be collected at each sample site are presented in Table B1-1.

The sampling process used results in a spatially balanced, random selection of sites.

TABLE B1-1: Assessment and Analysis Planned

LASAR No.	Subpopulation	Crew	Parameters
	Big Wall	Contractor	EMAP – See Above
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	Big Wall	Contractor	EMAP – See Above
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B2. Sampling Method Requirements

Physical Habitat Characteristics (for RBS)

The RBS calculation used will be the newest formulation of RBS described in by Kaufmann et al,2008a . The field methodology used is that described in EMAP-Western Pilot Field Operations Manual for Wadeable Streams, Section 7 (Physical Habitat Characterization), Rev. 1, April 2001, by Philip Kaufman et al. See the field protocol description above.

B3. Sample Handling and Custody Procedures

B4. Analytical Methods Requirements

All parameters will be measured using the protocols previously mentioned above. Specific references pertinent to this section are outlined below.

RBS

RBS will be calculated according to the most recent formulation, described in Kaufmann et al 2008a.

B5. Quality Control Requirements

There are no formal field collection requirements pertaining to QA/QC for the parameters collected and recorded for this scope of work.

GROUP C: ASSESSMENT AND OVERSIGHT

C1. Assessment and Response Actions

Surveillance and data management will be performed in a timely manner to ensure that the data being collected will meet the needs of the project. All results of the individual assessments will be compiled and managed by the contractor.

Response actions will be developed as data becomes available. Any stop work orders or change in project scope will come from the BLM Project Coordinator. Corrective actions will be documented as addendums to this SAP.

C2. Reports to Management

Reports will include the results and evaluations of the data metrics collected described within this SAP. Results will indicate either a) the population is not impaired for sedimentation or b) population is impaired for sedimentation and warrants further analysis and/or development of a TMDL.

Any results warranting a sedimentation source and budget analysis will require an addendum to this SAP to document procedures for that scope of work.

GROUP D: DATA VALIDATION AND USABILITY

D1. Data Review, Validation, and Verification

The Project Officer, QA Officer, and Data Manager will determine if the data collected meets the QA Plan objectives and will review all data resulting from this project as data becomes available. Decisions to accept, qualify, or reject data will be made by the Project Manager, QA Officer, and Data Manager.

D2. Validation and Verification Methods

Once the data has been entered into the project database and into LASAR, the Data Manager will proof a printed database report against the original field sheets. Errors in data entry will be corrected at that time. If data is collected electronically in the field, any discrepancies between that data and written field data will be brought to the attention of the Siuslaw Project Coordinator for clarification. Measurements resulting in data indices (RBS or MBI) outside expected thresholds will be examined to determine if erroneous field data may be contributing to the result. Data quality problems will be discussed as they occur and in the final report to data users.

D3. Reconciliation with Data Quality Objectives

If data quality indicators do not meet the project's specifications, data may be discarded and re-sampling may occur. The cause of the failure will be evaluated. If the cause is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, team members will be retrained. Any limitations on data use will be detailed in both interim and final reports, and other documentation as needed. If failure to meet project specifications is found to be unrelated to equipment, methods, or sample error, specifications may be revised for the next sampling season. Revisions will be submitted to the QA section of the DEQ Laboratory for review and/or approval.

Appendix A – Revision History

The plan author must increment the revision number with each approved revision. A new document is assigned a revision number of 1.0. The revision number of a plan that receives routine or minor editing is updated by incrementing the minor number by one (i.e., 1.0 becomes 1.1) The revision number of a document that has undergone major revisions is updated by incrementing the major number by one and setting the minor number to zero (i.e., 1.1 becomes 2.0). Revisions to documents should be clearly identified in a "Revision History" section of the document. The Revision History documents the specific changes made to the controlled document, who made the changes, and the date (month and year) the changes were made.

Table App-1 Revision History

Revision	Date	Changes	Editor

Appendix B – Bibliography

P.R. Kaufmann, J.M. Faustini, D.P. Larsen, M.A. Shirazi. (2008) ***A roughness-corrected index of relative bed stability for regional stream surveys***. Geomorphology 99 pp:150–170

Mico, C. and Mico L. (2007) **Sediment, Shade, and Complexity: Characterizing Ambient Water Quality & Physical Habitat in the Upper Nestucca River Stream Network**. Technical Report Prepared for the Bureau of Land Management, Contract #HAP064172.

Peck, D.V., J.M. Lazorchak, and D.J. Klemm (editors). (2001) Draft. ***Environmental Monitoring and Assessment Program -Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams***. EPA/XXX/X-XX/XXXX. U.S. Environmental Protection Agency, Washington, D.C.

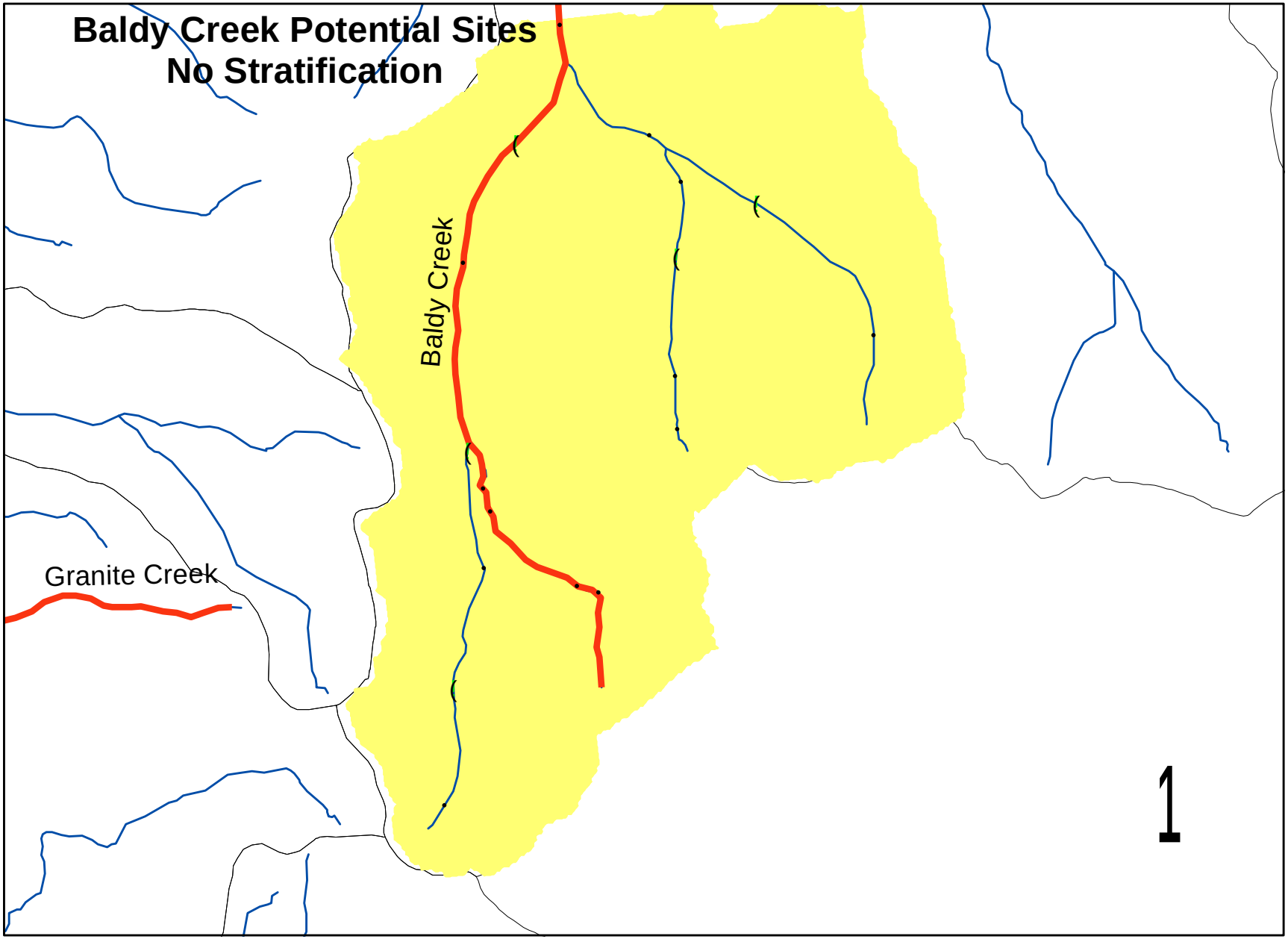
Stevens, D. L., Jr. and A. R. Olsen (2004). ***Spatially-balanced sampling of natural resources.*** Journal of American Statistical Association 99(465): 262-278.

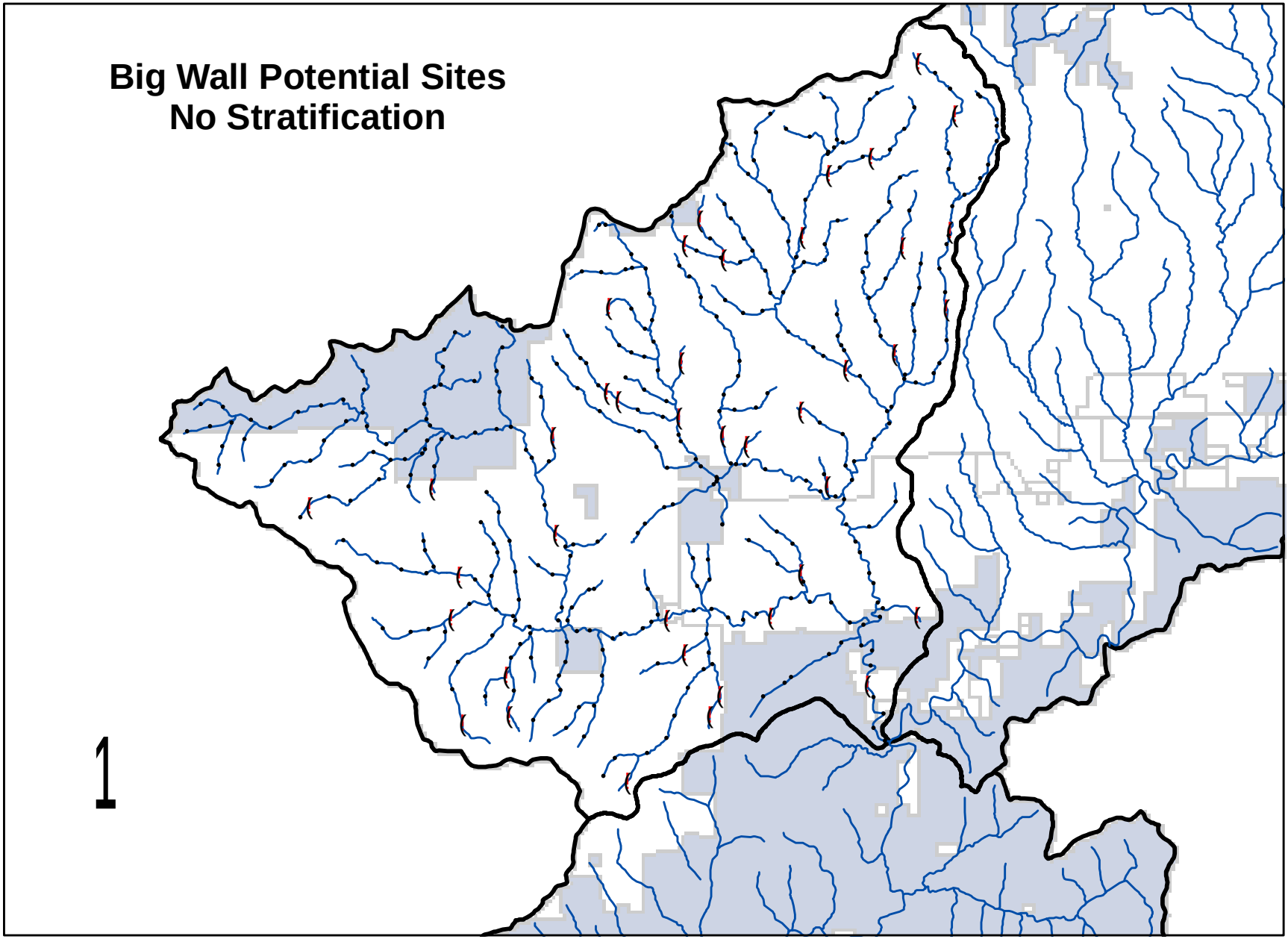
USFS (1997) ***Upper North Fork John Day Watershed Analysis***

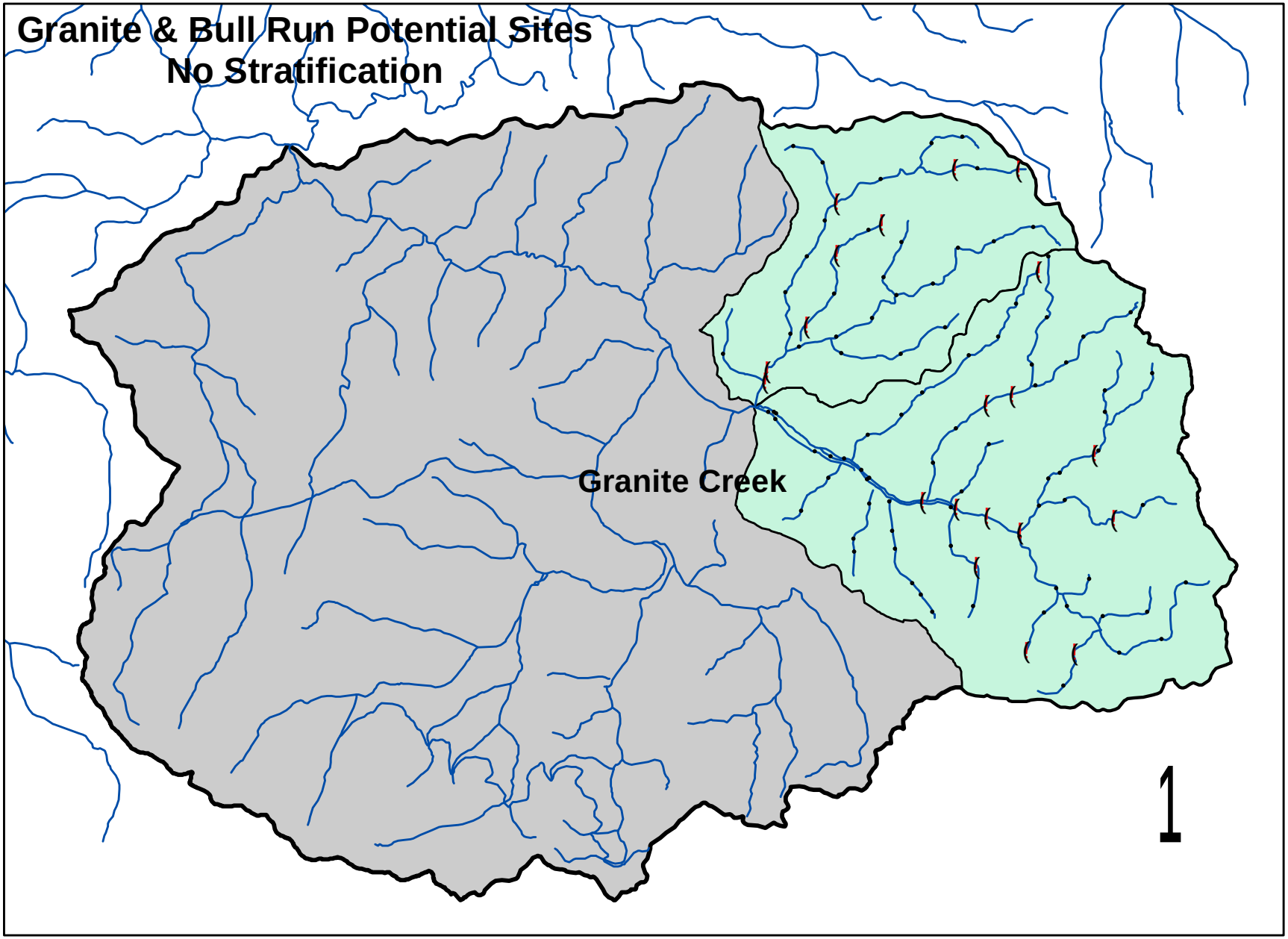
USFS (1997) ***Granite Creek Watershed Analysis***

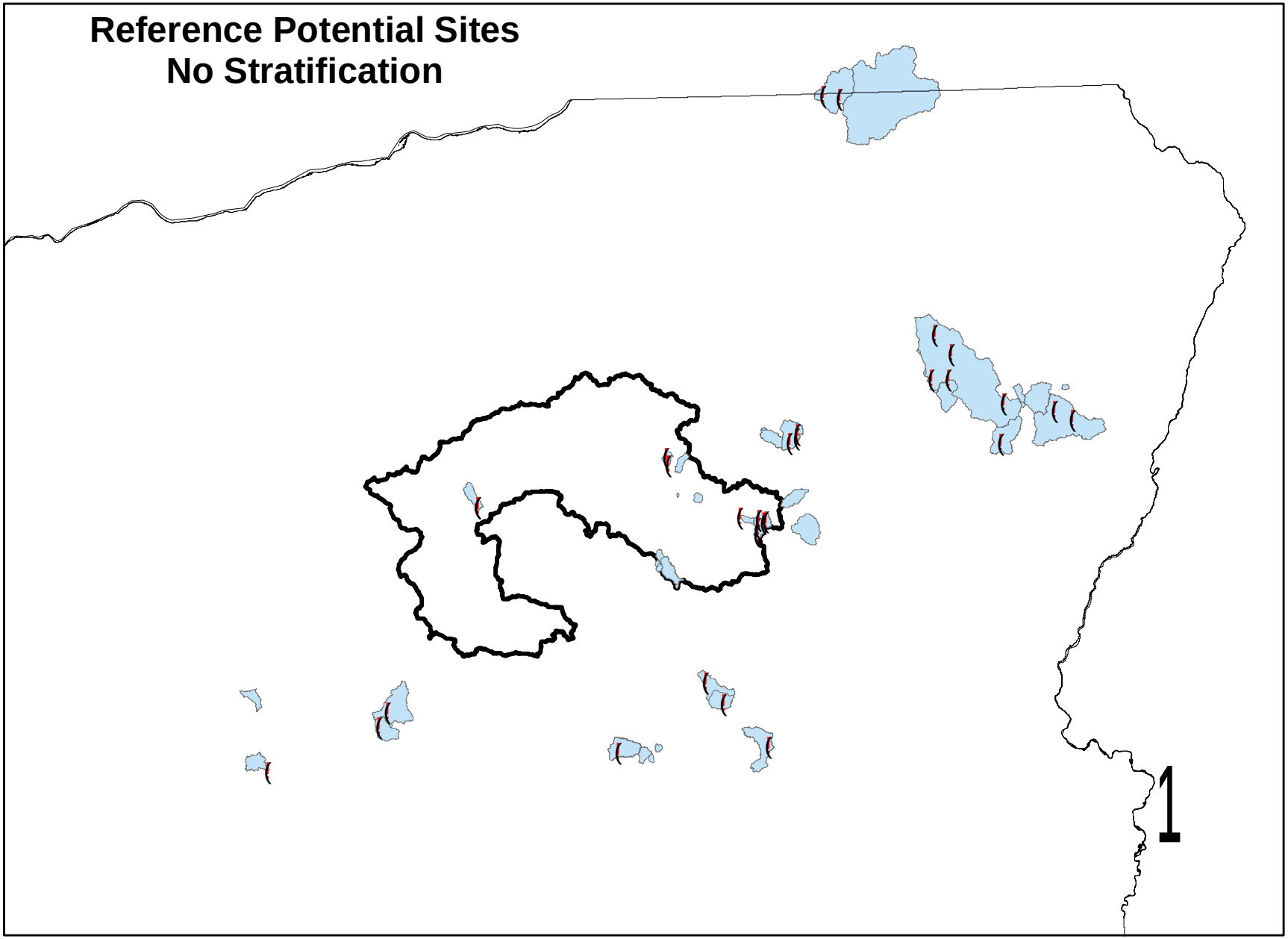
USFS (1995) ***Wall Ecosystem Analysis***

Geology Data Source - Oregon Geologic Data Compilation (OGDC) - Release 4 Issued by the Oregon Department of Geology and Mineral Industries DOGAMI)


Baldy Creek Potential Sites
No Stratification
Baldy Creek
Granite Creek
1


Big Wall Potential Sites
No Stratification
1


Granite & Bull Run Potential Sites
No Stratification
Granite Creek
1


Reference Potential Sites
No Stratification
1