99-142 Project Completion Report

Project Description

Over the last five years several technical assessments have been initiated throughout the Applegate River Basin. The studies include habitat surveys, water quality sampling, sediment sampling, fish passage, TMDL development, and watershed analysis. In all cases, lack of flow information is limiting conclusions. Flow is a necessary variable in determining timing and magnitude of watershed processes. Watershed processes drive temperature and chemical inputs as well as transport of inputs into the receiving water body. In many cases, flows define fish passage. Additionally, flow information is essential for temperature and sediment TMDL development.

In response to insufficient flow information, the Applegate River Watershed Council established twenty-four flow monitoring sites. At fifteen sites staff gages were installed. Discharge measurements were collected in 1999 and 2000. Details are included in Attachment – A *discharge accomplishments.*

In the Little Applegate River, a watershed analysis and the Pilot Integrated Team (PIT) project are currently active. In both assessments sediment was identified as a limiting factor to aquatic health. However, incomplete sediment data limited conclusions regarding source and quantity of sediment input. To better define sediment sources, suspended sediment samples were collected in the mainstem of the Little Applegate River and Yale Creek. Tributaries to Yale and the Little Applegate were also sampled. The information was necessary to identify high priority restoration sites and for monitoring. Details are included in Attachment – B *Suspended Sediment Accomplishments.*

Volunteer Efforts

Hans Rilling, project manager in 1999, field assistant and lab technician in 2000, donated over 1000 hours. Hans collected discharge information and installed staff gages. Hans also processed sediment field samples. In 1999, Hans supervised staff and managed the monitoring program. Tim Monfort and Dave Squires of the BLM donated staff plate materials and expertise in identifying appropriate gage locations. Tim and Dave donated 40 hours of time. Debbie Whitall and Mike Zan, hydrologists for the Roue River National Forest donated nearly 80 hours assisting with sampling design, site location, and data collection. Several residents in Williams Creek, Little Applegate River, and Cheney Creek granted access to their property for staff plate installation and donated time to read and record water surface elevations at staff plate locations.

Participants

Numerous individuals worked on the project in 1999 and 2000. They include: Hans Rilling, Mary Maier, David Livingston, Todd Reeve, Steve Sagmiller, Tim Franklin, Eric Miller, Carolyn Proctor, Mike Mathews, Laura Lambert, Christine Buffington and Rich Piakowski of the Applegate River Watershed Council (ARWC) and Evelyn Roether and Chris Church of the Williams Creek Watershed Council.

Materials and Methods

Discharge measurements followed USGS protocol. A price Pygmy/AA and Swoffer flow meters were used to collect velocity measurements. Discharge was calculated by multiplying cross sectional area by velocity. Staff plate calibration, or rating curve, was developed using several discharge-water surface elevation pairs. Measurements included a full range of flows. Discharge and associated water surface elevation were statistically evaluated to determine correlation. The evaluation generated a mathematical expression relating gage height to discharge. An adequate number of flow points were achieved when the correlation coefficient between discharge and water elevation reached 0.97 or greater.

In 2000, ARWC installed two continuous water depth recorders. The instruments recorded water depth every ½ hour. The relationship established between flow and depth at the staff plate was used to convert depth measured by the recorder to discharge.

Suspended sediment was collected using a DH-48 depth integrated suspended sediment sampler. Sampling procedure followed USGS protocols and entailed sampling the water column at 10-20 verticals along an established cross section. Samples were taken to the lab, filtered, dried and weighed. Results were recorded in mg/l. Integrating discharge information with measured suspended sediment generated sediment expressed in tons/day.

Results

Results are summarized in Attachment A—*Discharge* and Attachment B—*Suspended sediment*.

Accounting

Accounting and expenditures are included in billing statement.

Strengths and Weaknesses

The strength of the project is quality assurance and repeatability. Quality of data is essential for credible monitoring and TMDL development. The project established permanent reference sites ensuring consistent sampling locations. Protocols followed published USGS methods. Careful attention to protocols facilitates data comparisons between locations and years. Additionally, numerous individuals representing agencies, watershed councils and private citizens were involved with the study. Through the study, awareness and knowledge of watershed processes and conditions have increased.

Variability in sedimentation and transport reduces the statistical robustness of suspended sediment conclusions. Although the data are accurate, the collected data represent sediment discharge at that point in time and may not represent true, or absolute, sediment discharge from the basin. However, the data provide useful information. Specifically, relative sediment input from the subbasins can be determined. This knowledge assists in determinng high priority areas needing further investigation and/or restoration. To improve representation of true conditions in the subbasin, additional suspended sediment samples need to be collected.

Attachment A
Discharge Accomplishments

Measurement of flow has been a part of the watershed council's monitoring program since 1998. Table 1 lists the site locations and the attached Map displays the distribution.

Table 1. Stream Flow Locations

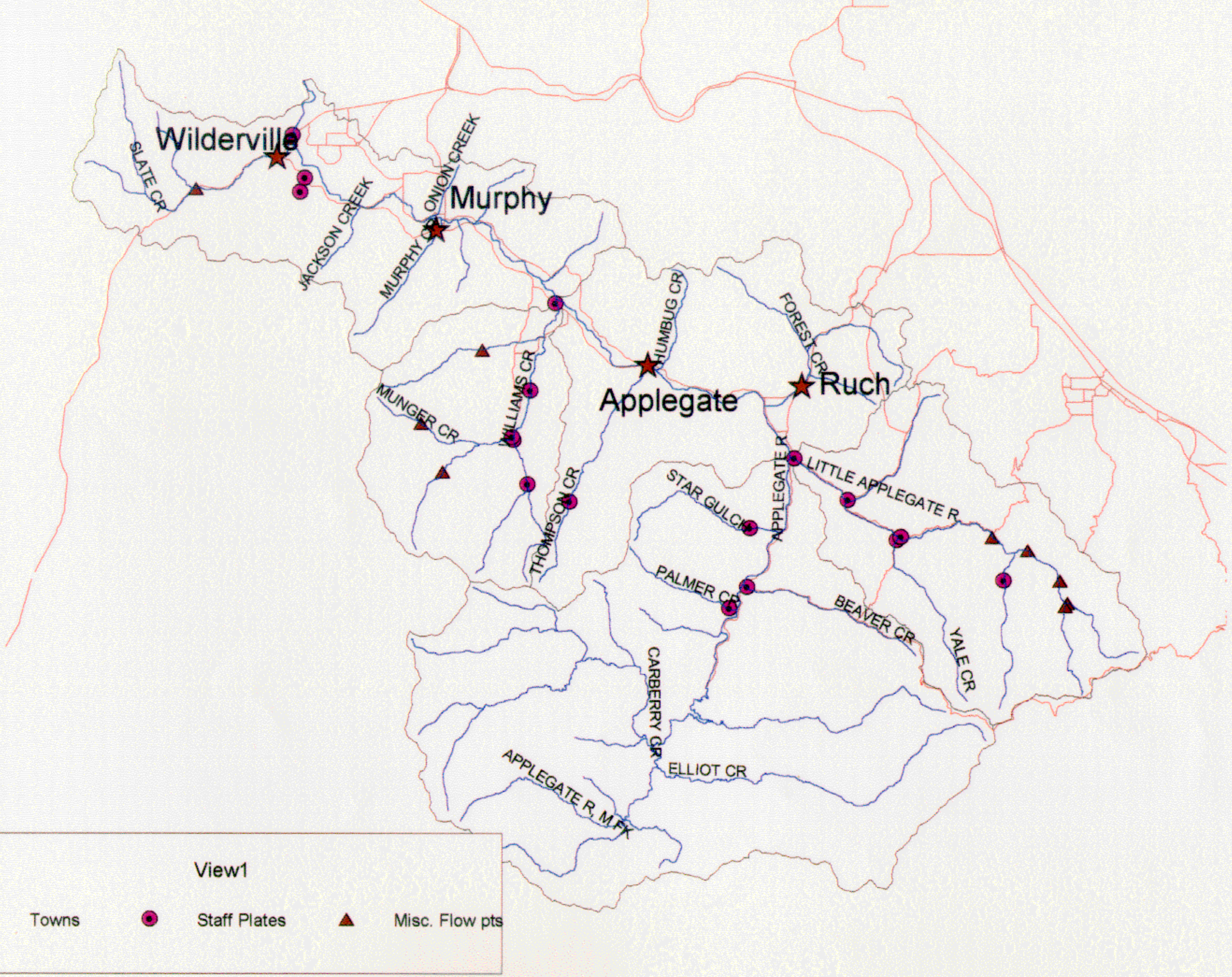
Location	
Cheney Ck below Little Cheney Ck	*Little Applegate @ Mouth*
EF Williams @ Mouth	*Little Applegate abv Yale*
EF Williams blw Rock Creek	Little Applegate abv Glade Ck
WF Williams @ Mouth	Little Applegate @ McDonald Ck
WF Williams @ Mile Marker 2	Little Applegate @ Tunnel Ridge Trail
Munger Creek	*Yale Ck @ Mouth*
Powell Creek	*Sterling Creek @ Mouth*
Williams Creek @ Mouth	*Glade Ck*
Williams Creek @ Williams Hwy	Grouse Ck
Slate Creek @ Mouth	*Palmer Creek*
Slate Creek @ Water Ck	*Beaver Creek*
Thompson Creek blw TallowBox	Cheney Ck nr Mouth

Fifteen of the 24 flow locations maintain a permanent gauge plate (sites italicized). At each gauged site, several discharges were measured representing a range of stream elevations. From the discharge-water surface elevation pairs rating curves were established (chart 1,2 examples). The curves allow for simple and quick determination of discharge. Staff, volunteers and residents simply read the gauge height for discharge determination. The flow information is useful for sediment transport energies, relating water quality to discharge, and for residents interested in their streams. DEQ has requested and received flow information needed to develop a temperature and sediment TMDL.

In 2000, ARWC installed two water stage recorders for continuous streamflow measurement in the Little Applegate River and Williams Creek (charts 3,4). Monitoring summer low flows and the influence of the "Farmers Ditch" diversion is the objective of Little Applegate gauge. In summary, the Farmers Ditch project is a change in point of diversion from the Little Applegate to the mainstem Applegate River. The point of diversion change will result in approximately a ten-fold increase in summer low flows. The 2000 data will provide baseline information prior to implementation of the Farmers Ditch project. Identical measurements will be made after project implementation.

In Williams Creek, water diversions dewater the lower reaches of the mainstem. The 2000 information displayed patterns of irrigation use. With this information, residents and the Williams Creek Watershed Council are currently planning alternative water diversion practices to alleviate poor summer flow conditions.

Applegate River Basin



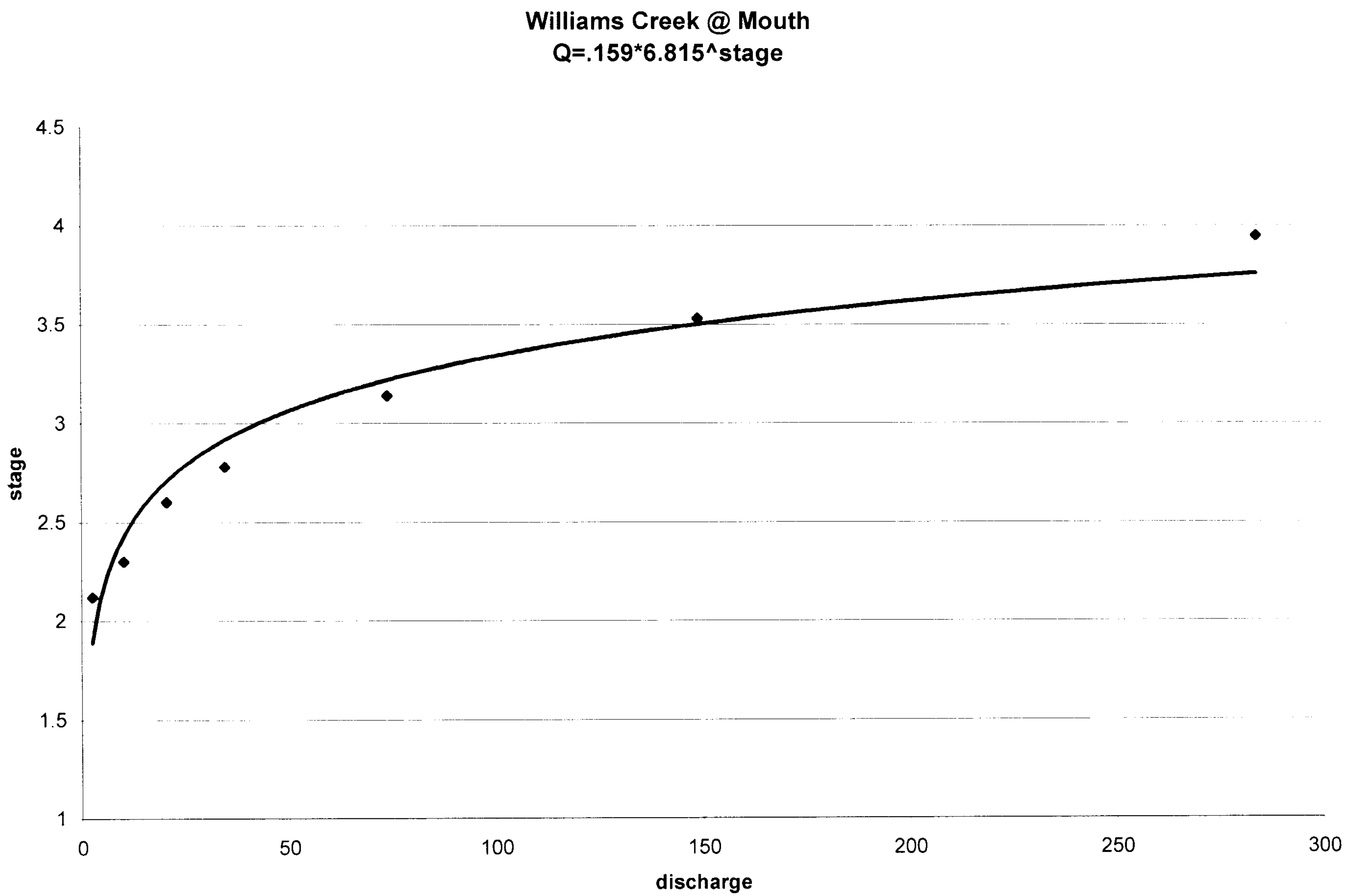
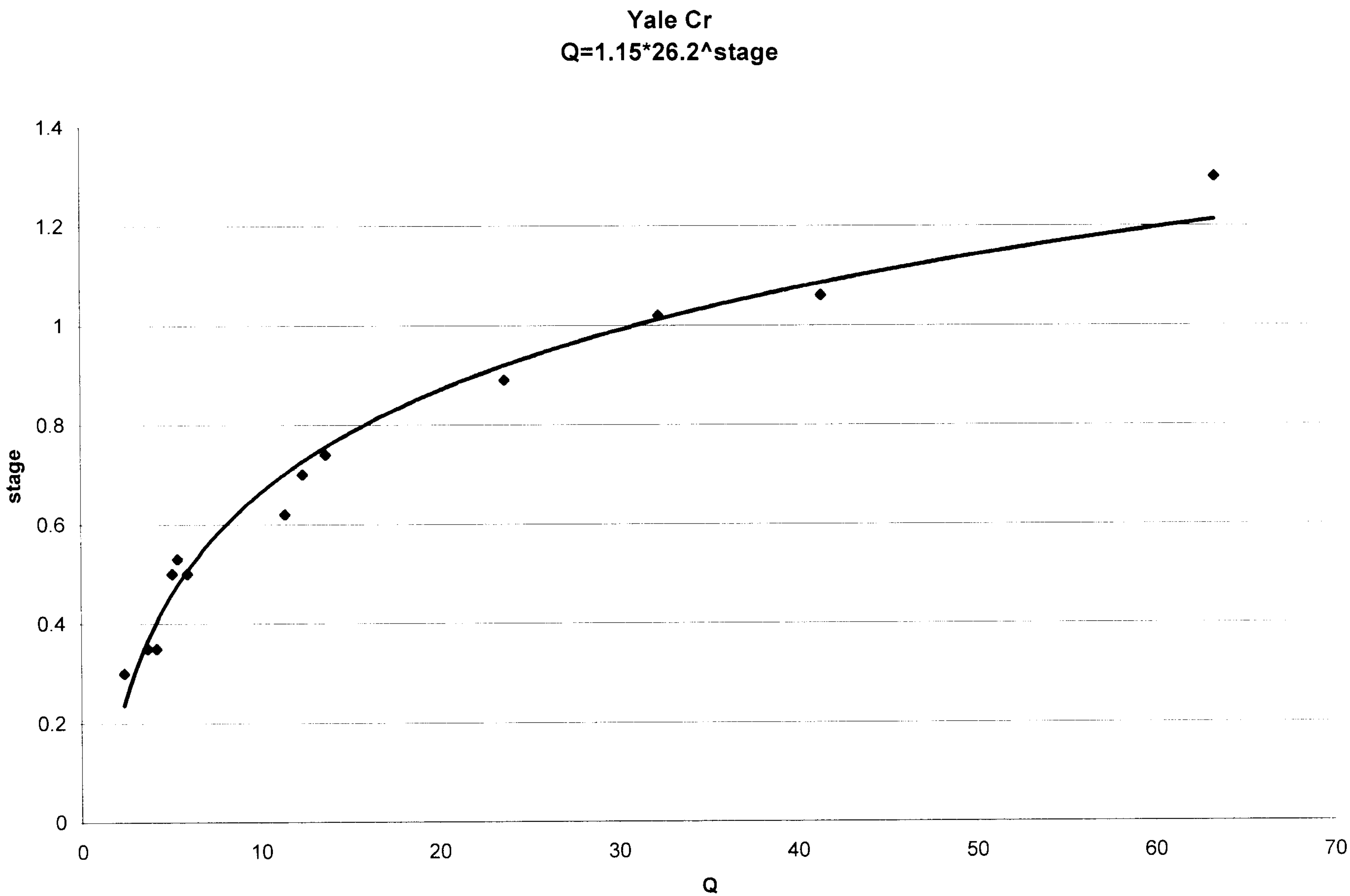

Williams Creek @ Mouth
Q=.159*6.815^stage
4.5
4
3.5
3
2.5
2
1.5
1
stage
0
50
100
150
200
250
300
discharge

Chart 1



Yale Cr
Q=1.15*26.2^stage
stage
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
60
70
Q

Chart 2

Little Applegate hydrographs

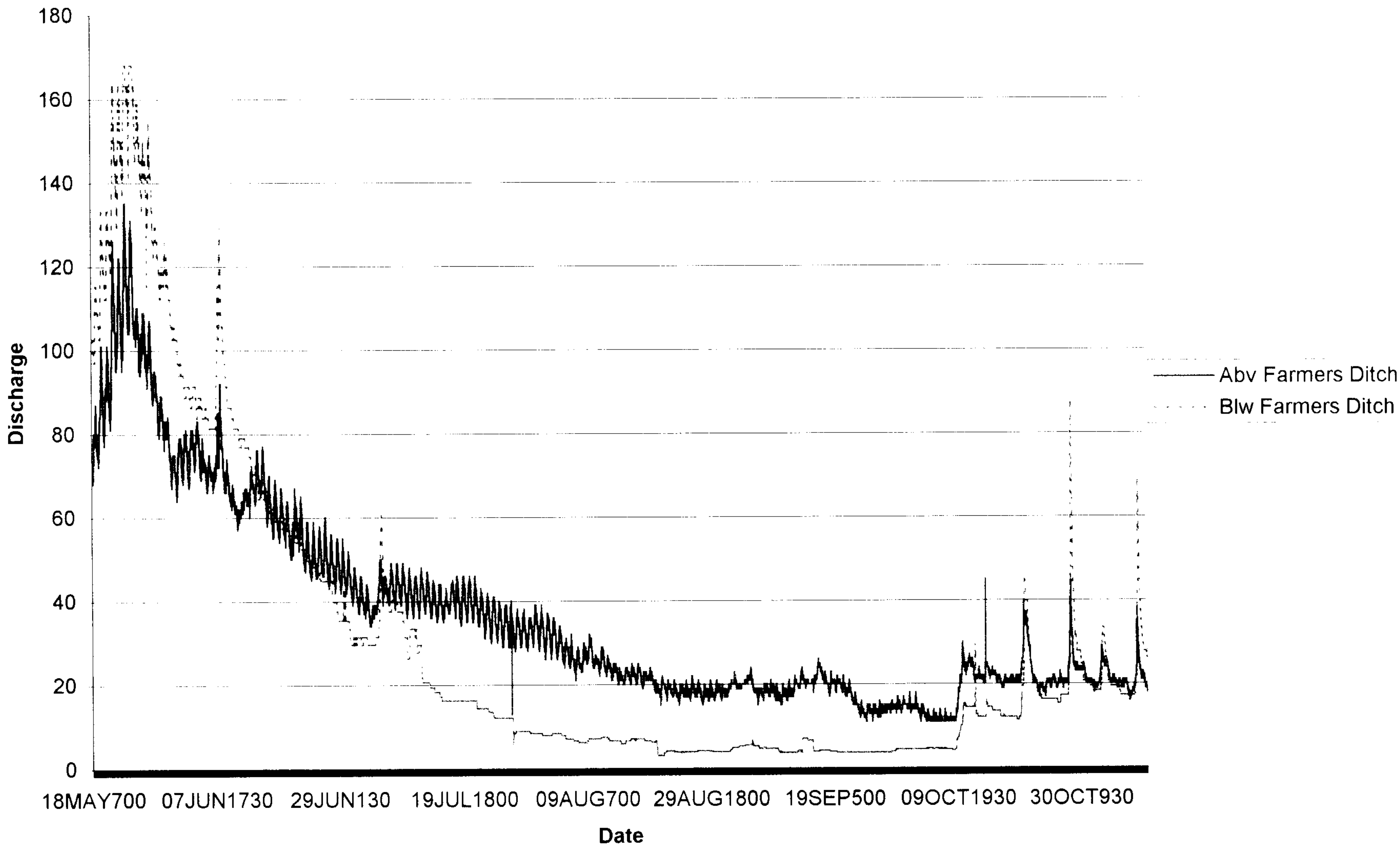


Chart 3

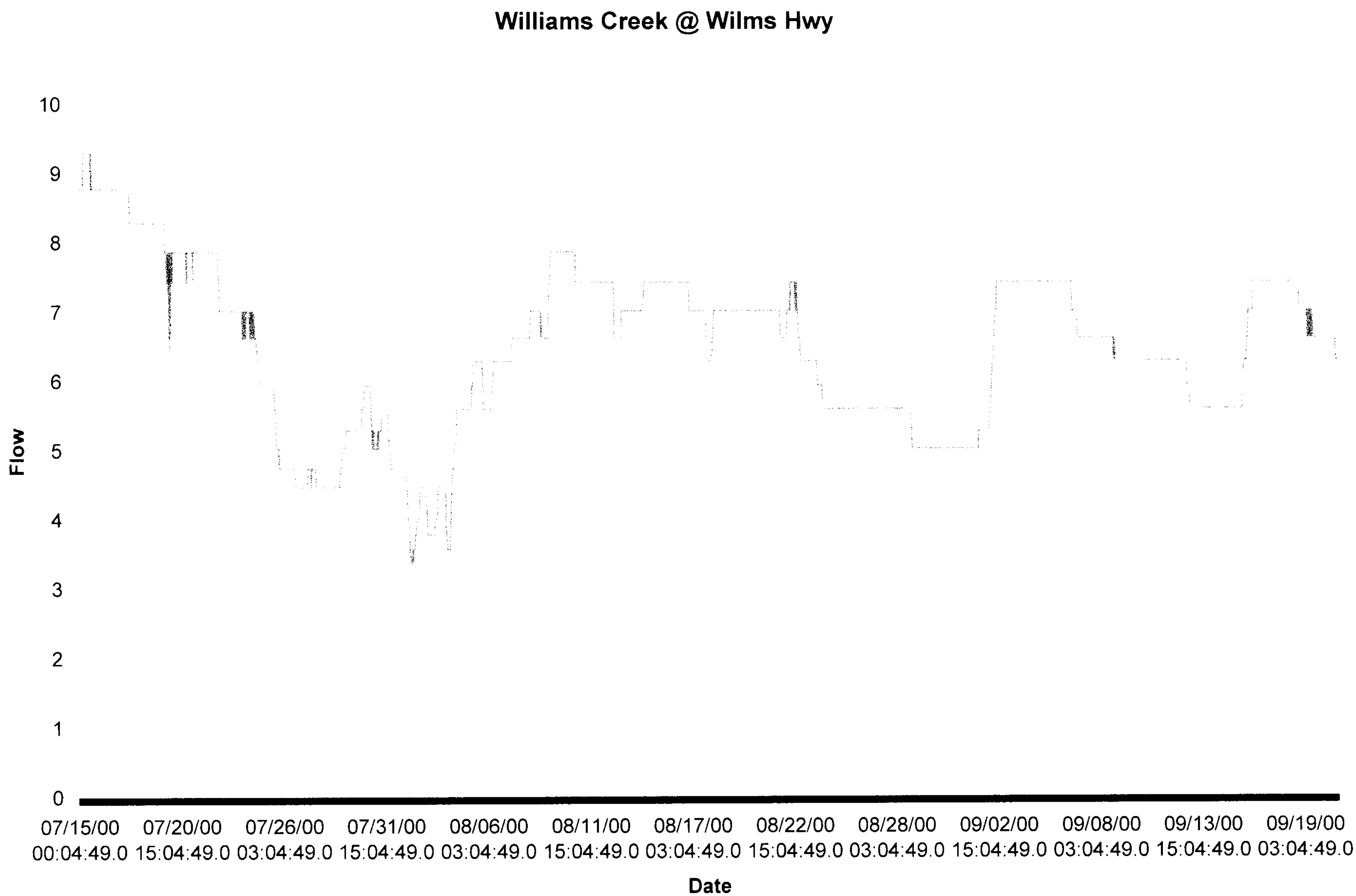

Williams Creek @ Wilms Hwy
10
9
8
7
6
5
4
3
2
1
0
Flow
07/15/00 00:04:49.0
07/20/00 15:04:49.0
07/26/00 03:04:49.0
07/31/00 15:04:49.0
08/06/00 03:04:49.0
08/11/00 15:04:49.0
08/17/00 03:04:49.0
08/22/00 15:04:49.0
08/28/00 03:04:49.0
09/02/00 15:04:49.0
09/08/00 03:04:49.0
09/13/00 15:04:49.0
09/19/00 03:04:49.0
Date

Chart 4

Attachment B
Suspended Sediment Accomplishments

Suspended sediment was measured in the mainstem of the Little Applegate River and Yale Creek. Tributaries to both Yale and the Little Applegate were also measured. A depth integrated suspended sediment sampler along with measured discharge information were used to develop sediment discharge (tons/day). Dates of sampling coincided with high flow events.

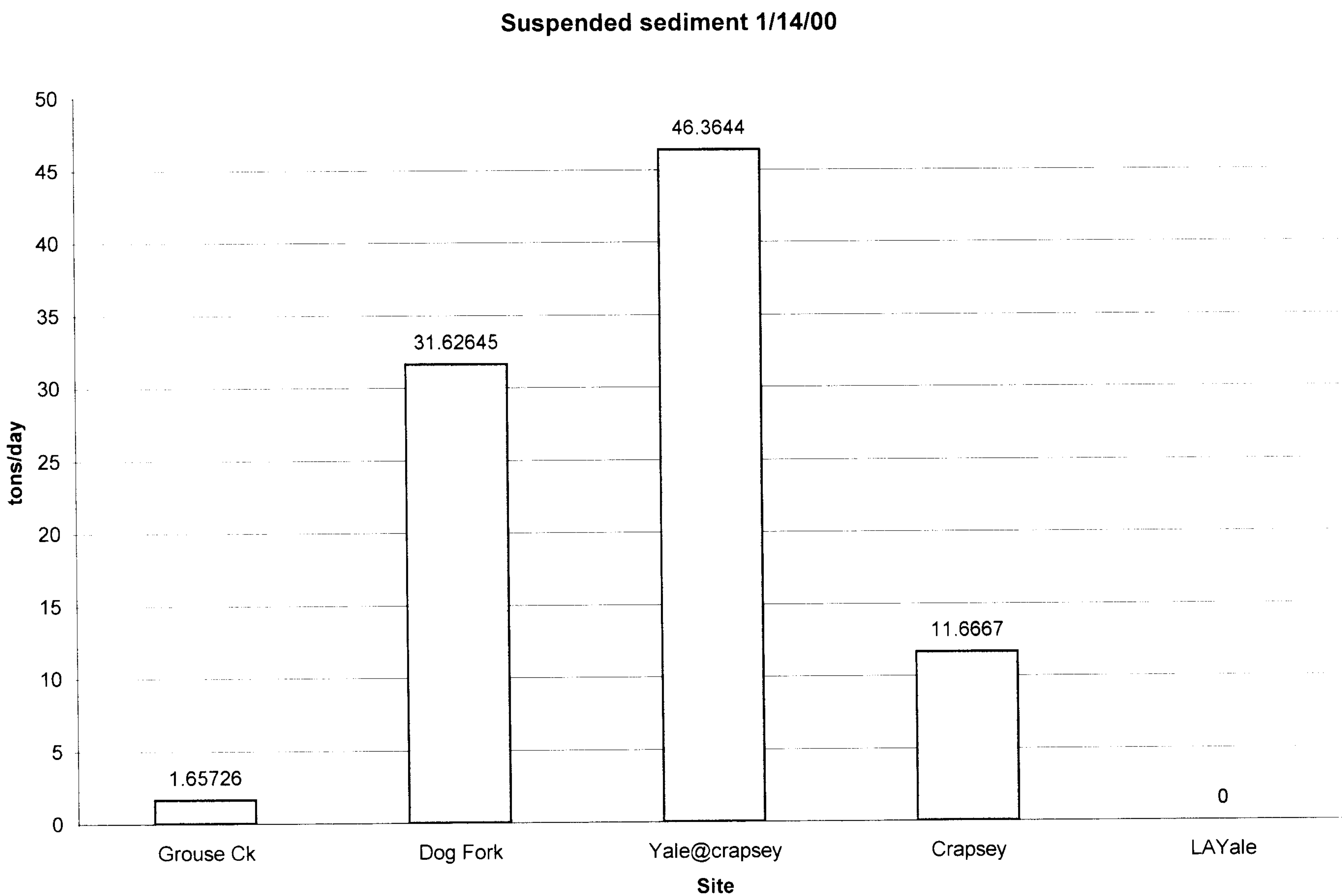
Suspended sediment discharge is a function of supply, in-channel transport rates and storm intensity. Due to the variability of sedimentation (introduction of sediment to streams) and transport, caution should be used in interpreting sediment discharge data. The high flows that scour out fines and the rains that bring sediment in from roads, cultivated fields and other disturbed areas are uneven with respect to time and space. Based on one year of data, which occurred in a relatively low flow year, only general interpretations can be made.

1. Upper Yale and Dog fork, a tributary to upper Yale, appear to generate the greatest amount of sediment per drainage area (**See Charts**: Suspended Sediment and Storm event). This supposition is supported by the US Forest Service's investigations of slope stability. The investigations identify multiple unstable terrains including landslide activity, debris flow activity and earth flows in the Upper Yale Basin. Conversely, Grouse Creek data indicate that sediment discharge is relatively low. The US Forest Service identified few unstable terraines in Grouse Creek basin.
2. Sediment discharge in streams can be classified as source limited and transport limited. In a source-limited stream, suspended sediment will not correlate with stream flows as sediment is introduced sporadically as "slugs". Transport limited streams have a constant supply of sediment; sediment discharge, then, is a function of stream power (ability to mobilize the sediment). A transport-limited stream will generally show a correlation between sediment discharge and flow. Based on this relationship, Crapsey Gulch and Yale Ck @ Crapsey are supply limited while Glade, Grouse, and Dog Fork are transport limited. **See chart**: *suspended sediment vs. discharge*)

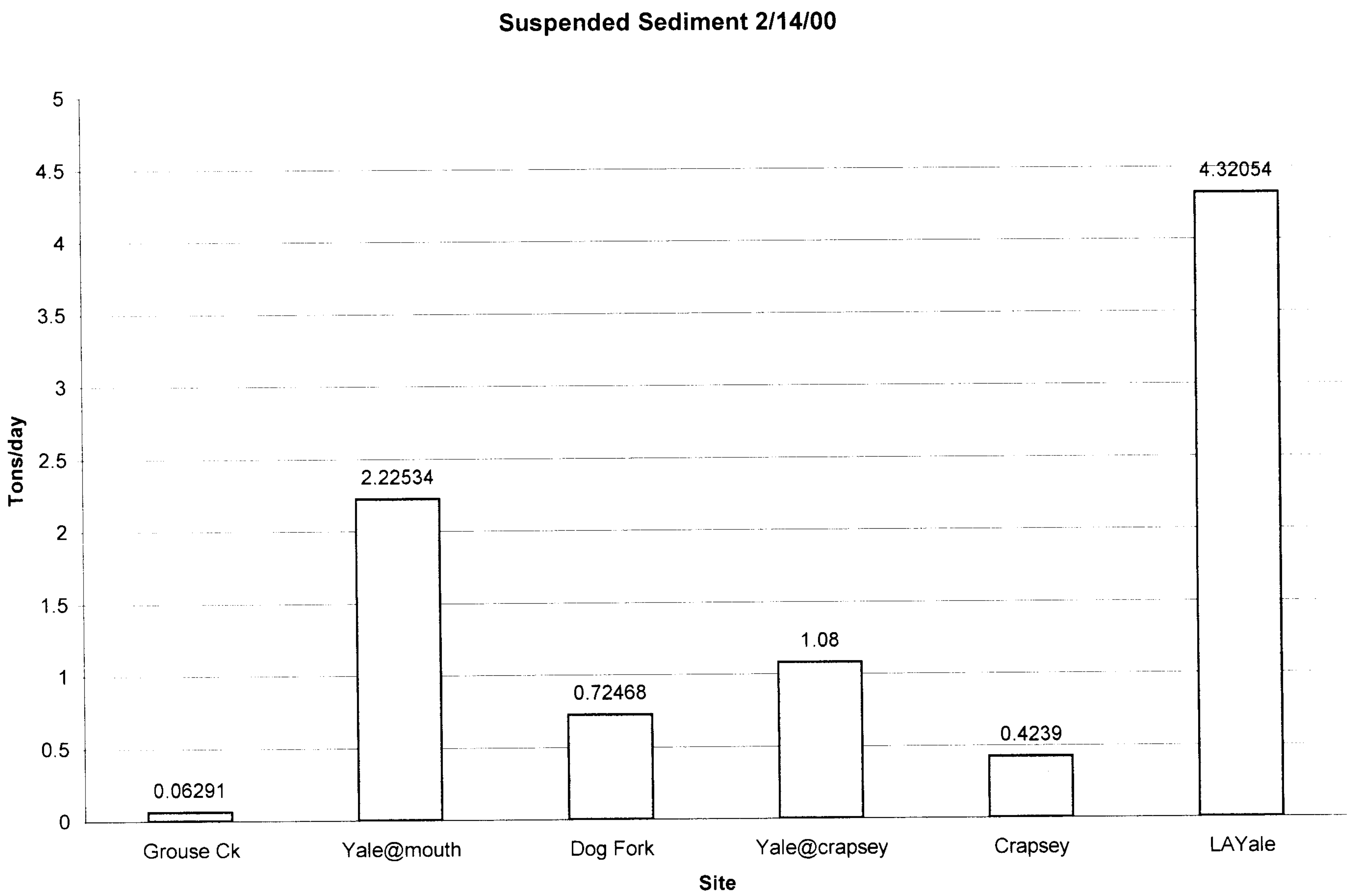
What Next...

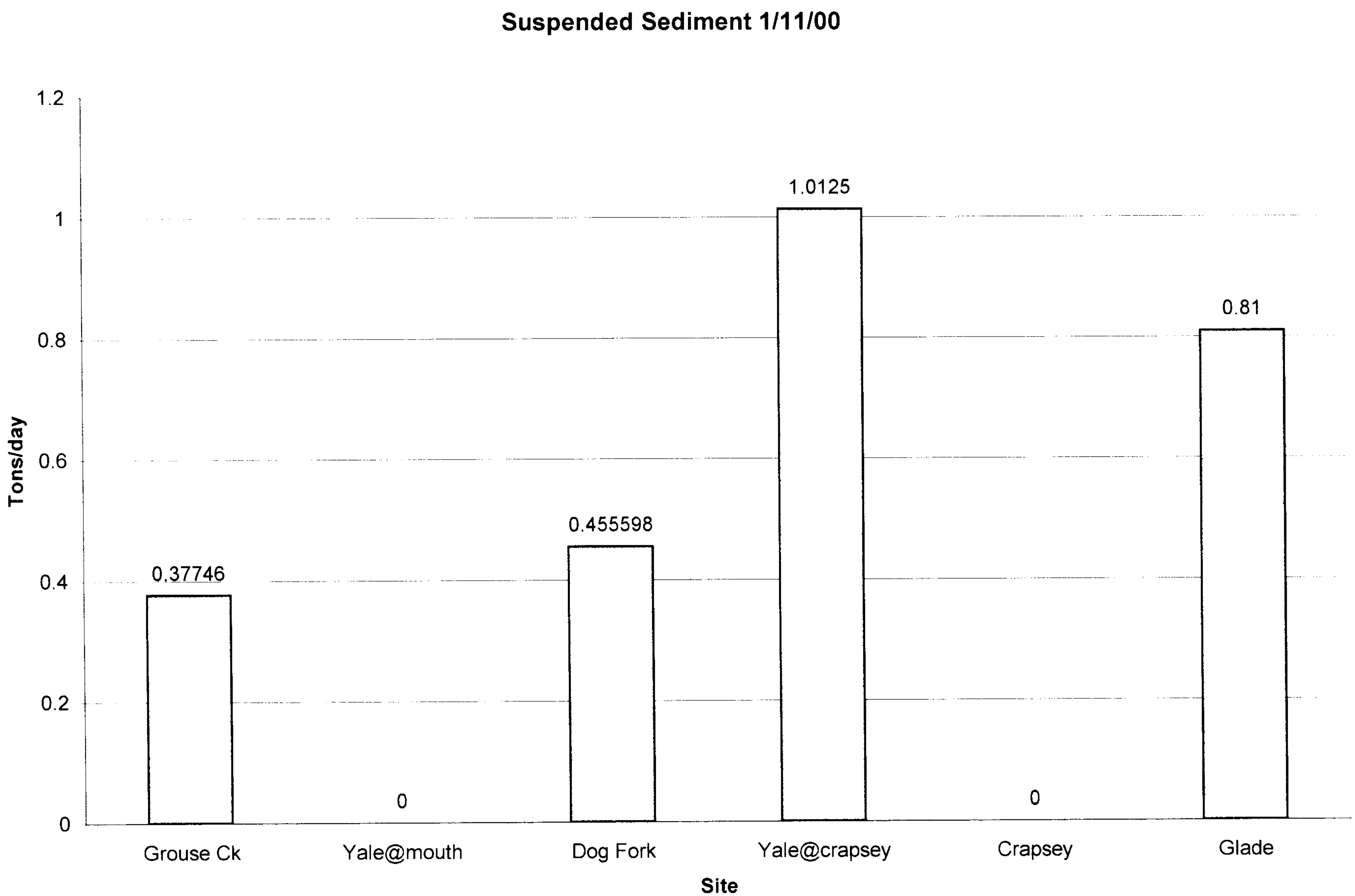
One of the goals of monitoring is to enable us to locate areas where restoration projects could have maximum benefit. Preliminary findings point to high priority subbasins needing further investigation. With more detailed and refined data combined with existing assessments, it will be possible to localize sediment sources, enabling us to pinpoint project sites.

In the winter of 2000-2001, ARWC will continue sediment studies in the Little Applegate River and Yale Creek. Continued depth integrated suspended sediment sampling will allow us to identify geographic areas contributing the greatest amount of sediment. The information will be used as a monitoring tool for the Pilot Integration Team (PIT) and for restoration prioritization.



Suspended sediment 1/14/00
50
45
40
35
30
25
20
15
10
5
0
tons/day
46.3644
31.62645
11.6667
1.65726
0
Grouse Ck
Dog Fork
Yale@crapsey
Crapsey
LAYale
Site


Suspended Sediment 2/14/00
Tons/day
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.06291
2.22534
0.72468
1.08
0.4239
4.32054
Grouse Ck
Yale@mouth
Dog Fork
Yale@crapsey
Crapsey
LAYale
Site


Suspended Sediment 1/11/00
Tons/day
1.2
1
0.8
0.6
0.4
0.2
0
0.37746
0
0.455598
1.0125
0
0.81
Grouse Ck
Yale@mouth
Dog Fork
Yale@crapsey
Crapsey
Glade
Site

Suspended Sediment and Discharge 1999-2000 data for Yale Creek and Little Applegate River