Prescribing Instream Flows in Small North Coastal California Streams

How My Instream Flow Should Behave Itself

Maintain High Stream Productivity

Maintain Good Juvenile Salmonid Rearing

Keep Redds Inundated

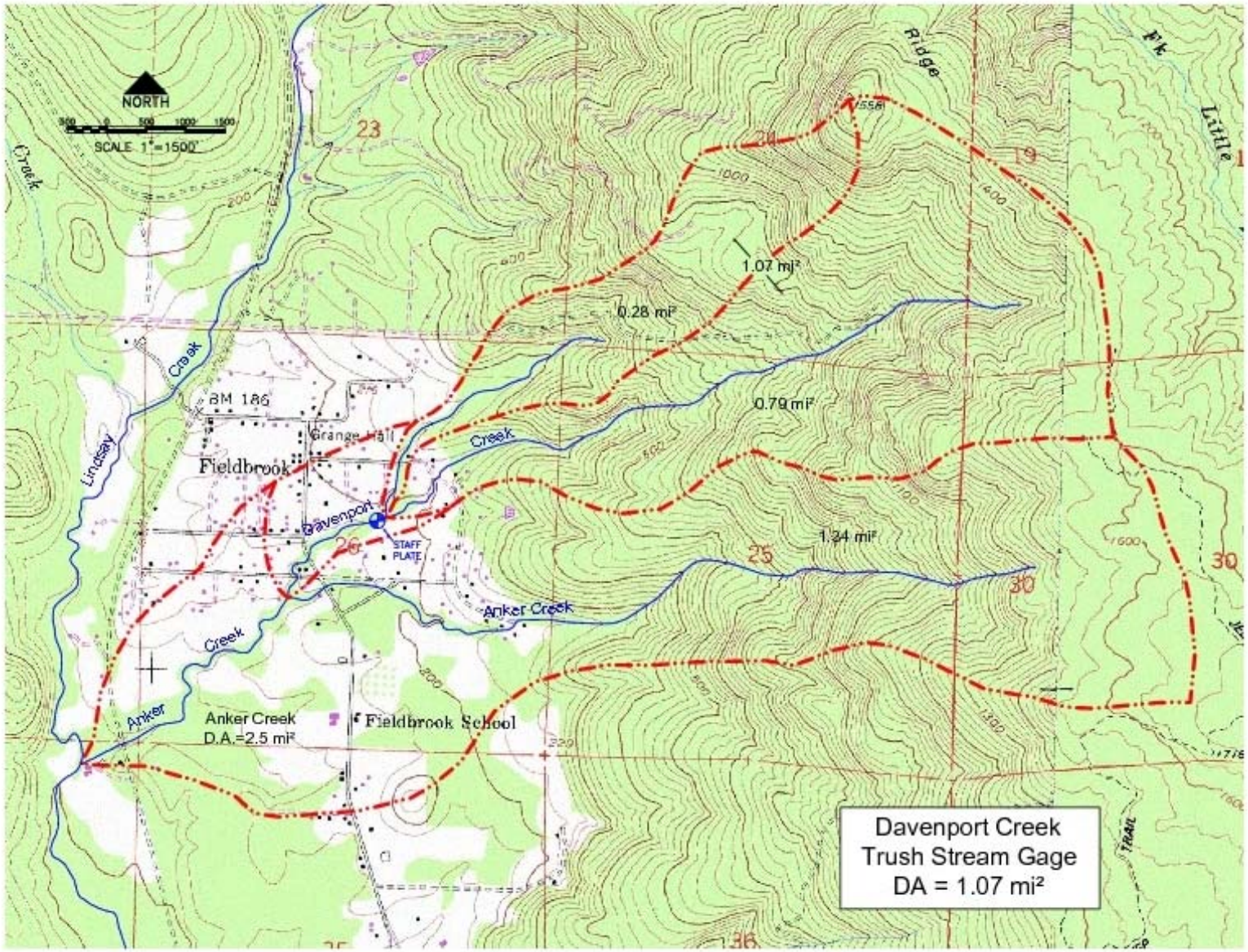
Don’t Want to Impede Adult Migration

Don’t Want to Add Stress and Vulnerability

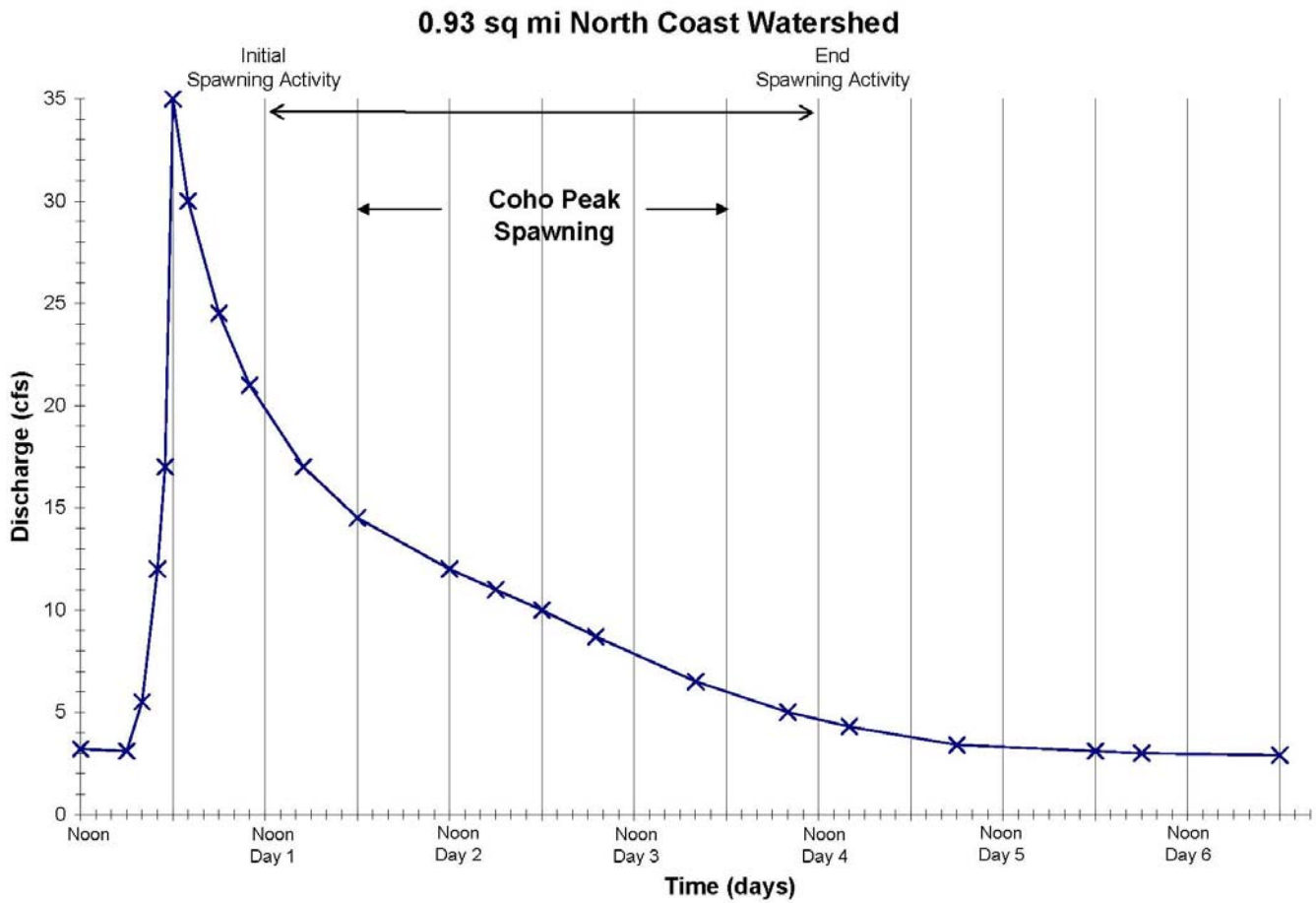
Don’t Want to Lose Habitat Availability

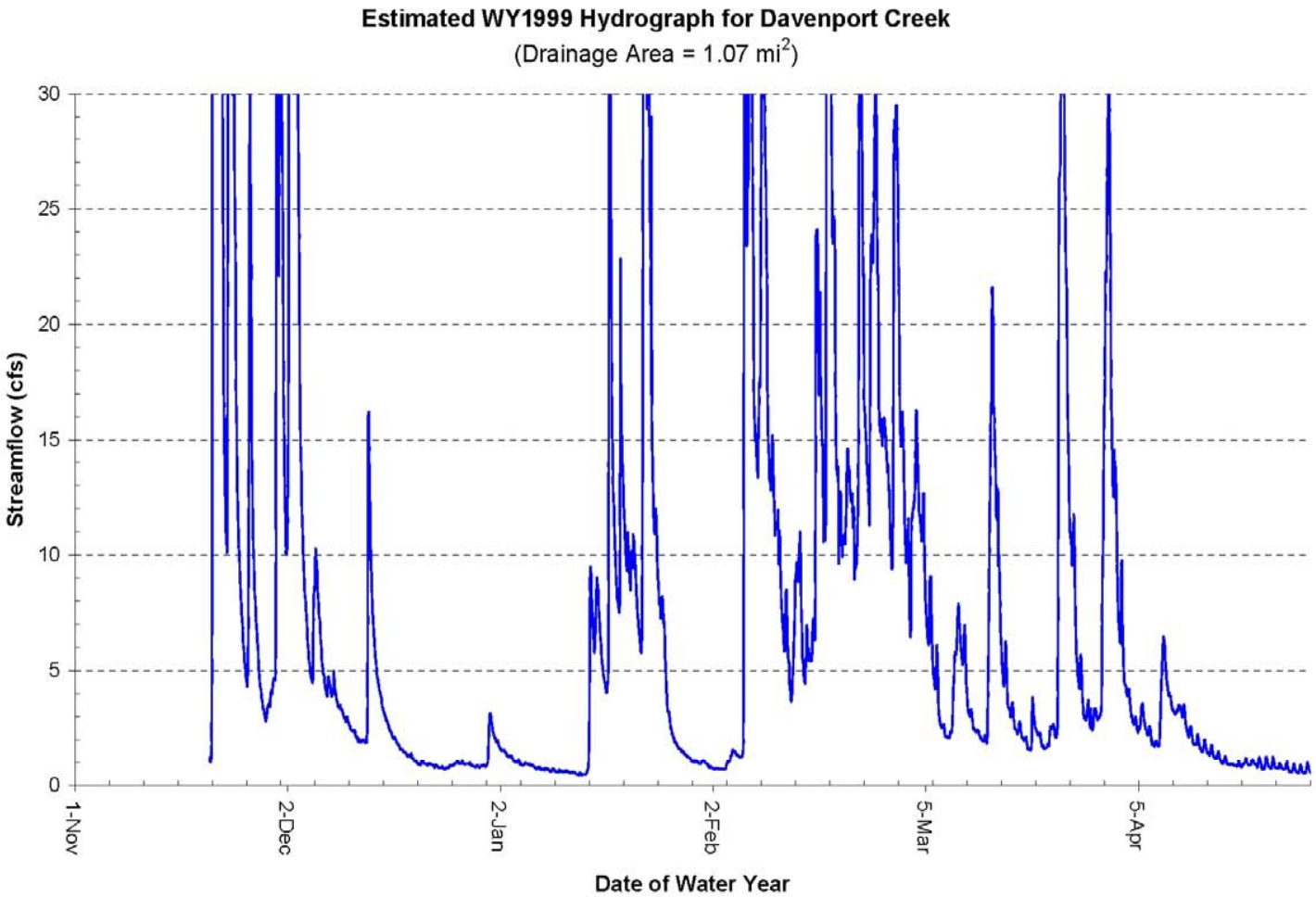
Encourage Fluvial Processes

Re-Arrange Large Woody Debris


NORTH
SCALE 1"=1500'
Lindsay Creek
BM 186
Grange Hall
Fieldbrook
Davenport
STAFF PLATE
Creek
Anker Creek
Anker Creek
D.A.=2.5 mi²
Fieldbrook School
1.07 mi²
0.28 mi²
0.79 mi²
1.24 mi²
Ridge
Davenport Creek
Trush Stream Gage
DA = 1.07 mi²

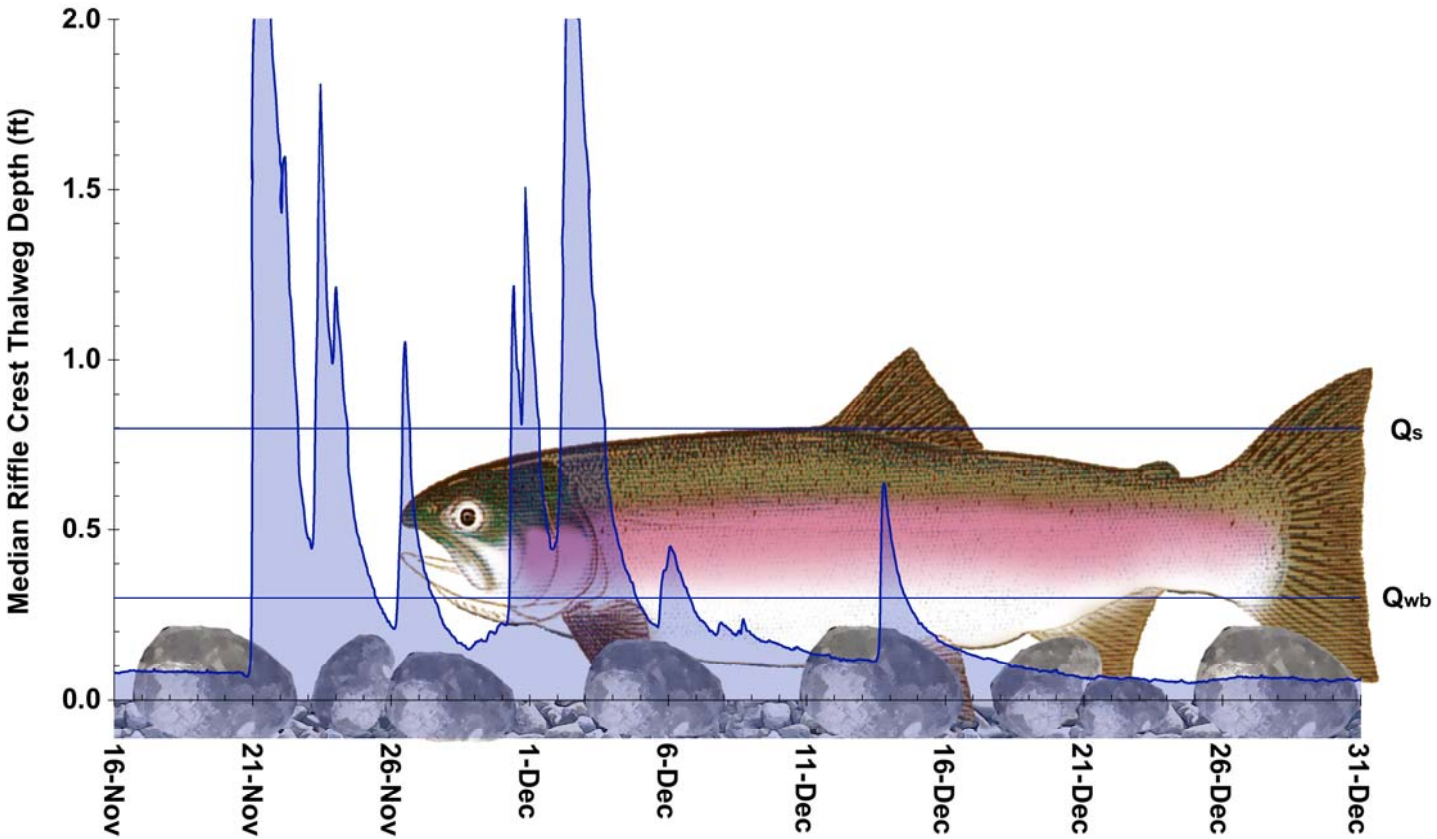
Davenport Creek (1.07 mi2)
Streamflow = 11 cfs

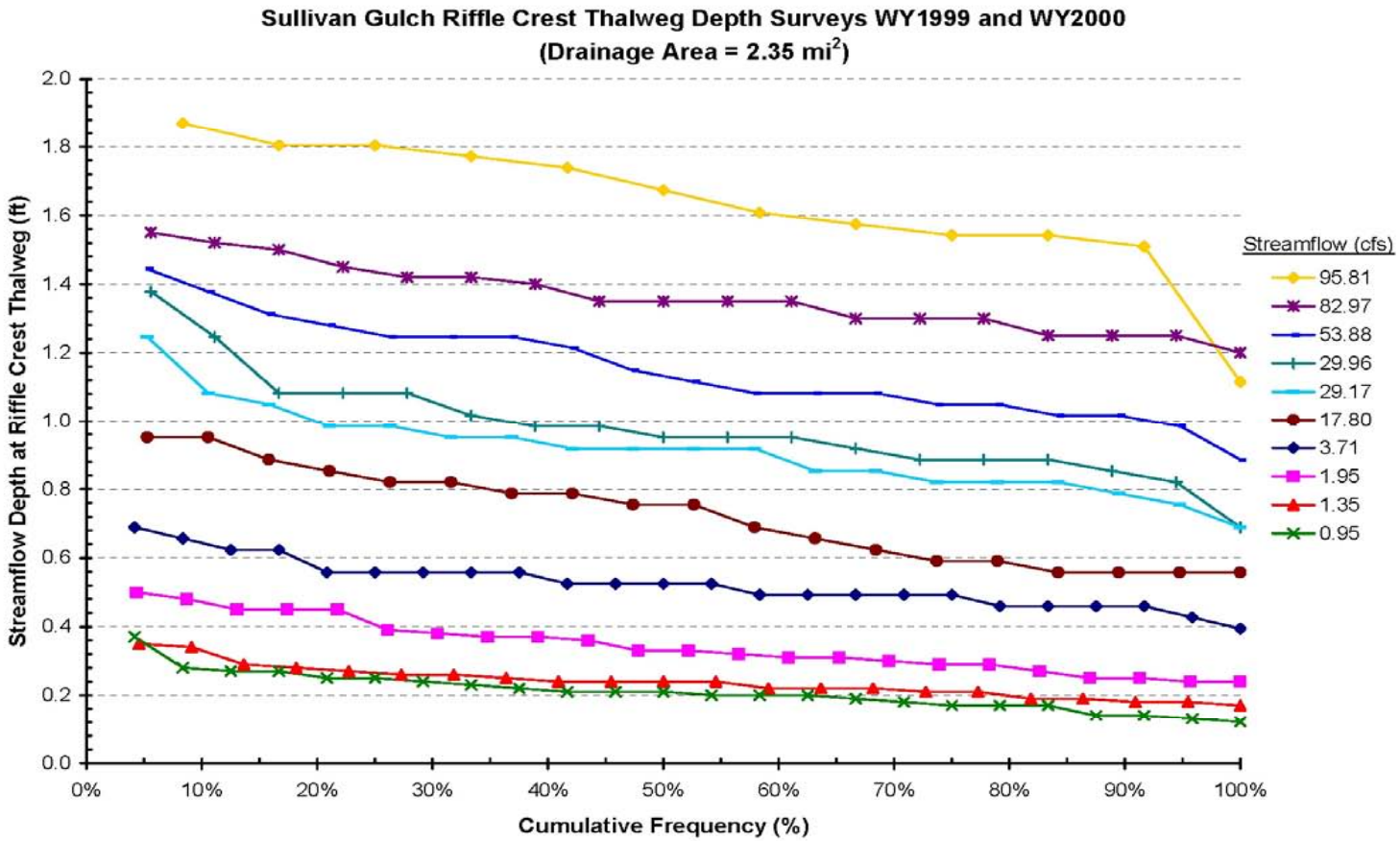

0.93 sq mi North Coast Watershed
Initial
Spawning Activity
End
Spawning Activity
Coho Peak
Spawning
Discharge (cfs)
0
5
10
15
20
25
30
35
Noon
Noon
Day 1
Noon
Day 2
Noon
Day 3
Noon
Day 4
Noon
Day 5
Noon
Day 6
Time (days)


Estimated WY1999 Hydrograph for Davenport Creek
(Drainage Area = 1.07 mi2)
Streamflow (cfs)
30
25
20
15
10
5
0
1-Nov
2-Dec
2-Jan
2-Feb
5-Mar
5-Apr
Date of Water Year

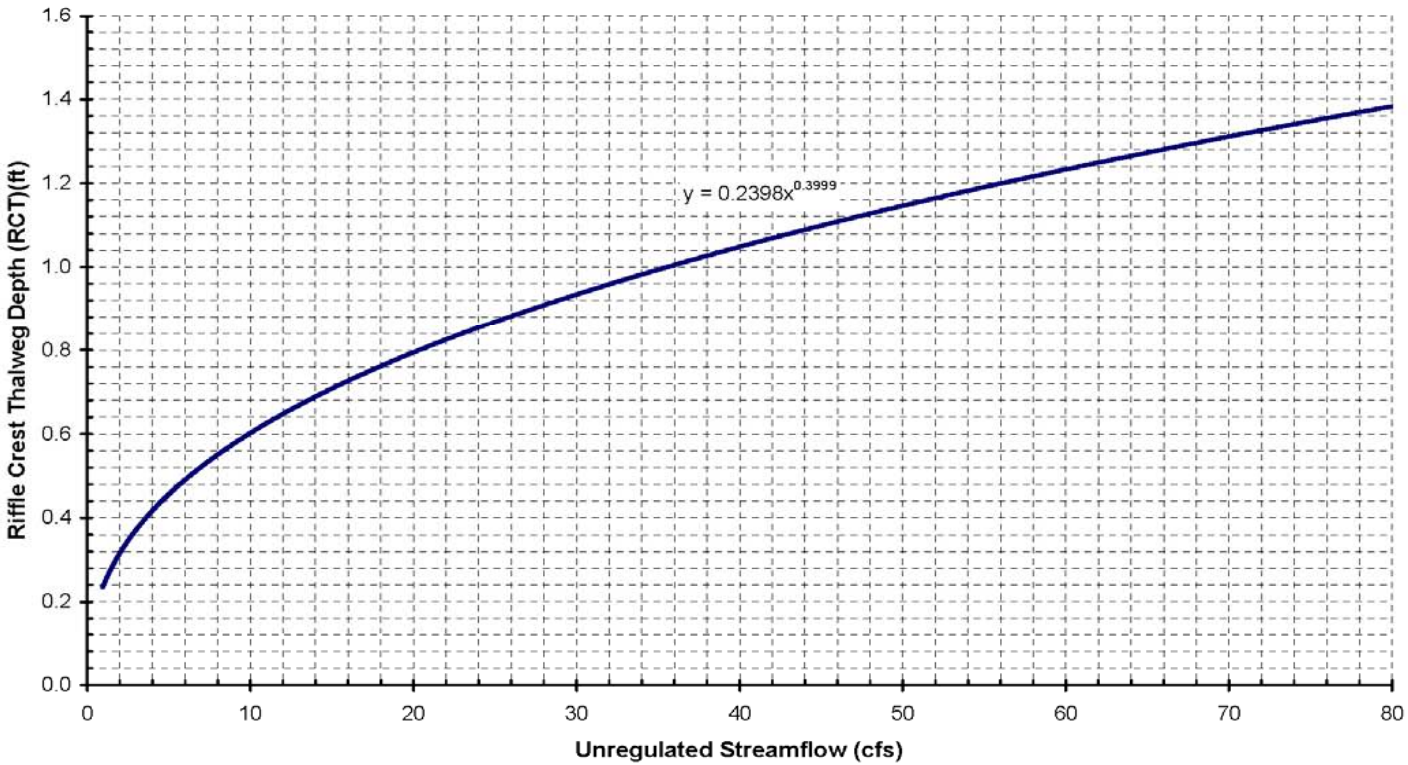
Riffle Crest Thalweg

ESTIMATED WY1999 STAGE-O-GRAPH FOR DAVENPORT CREEK
(Drainage Area = 1.07 mi^2 at Stream Gage)

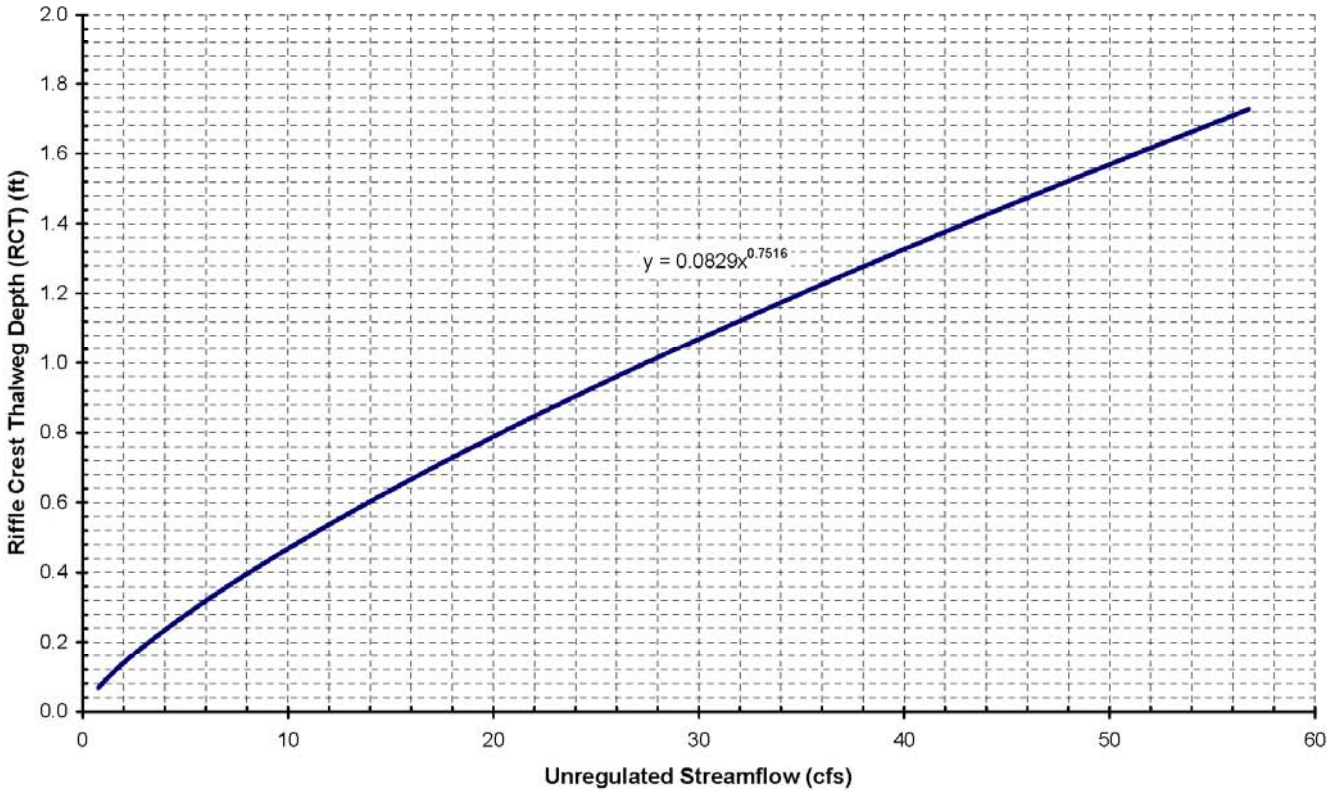


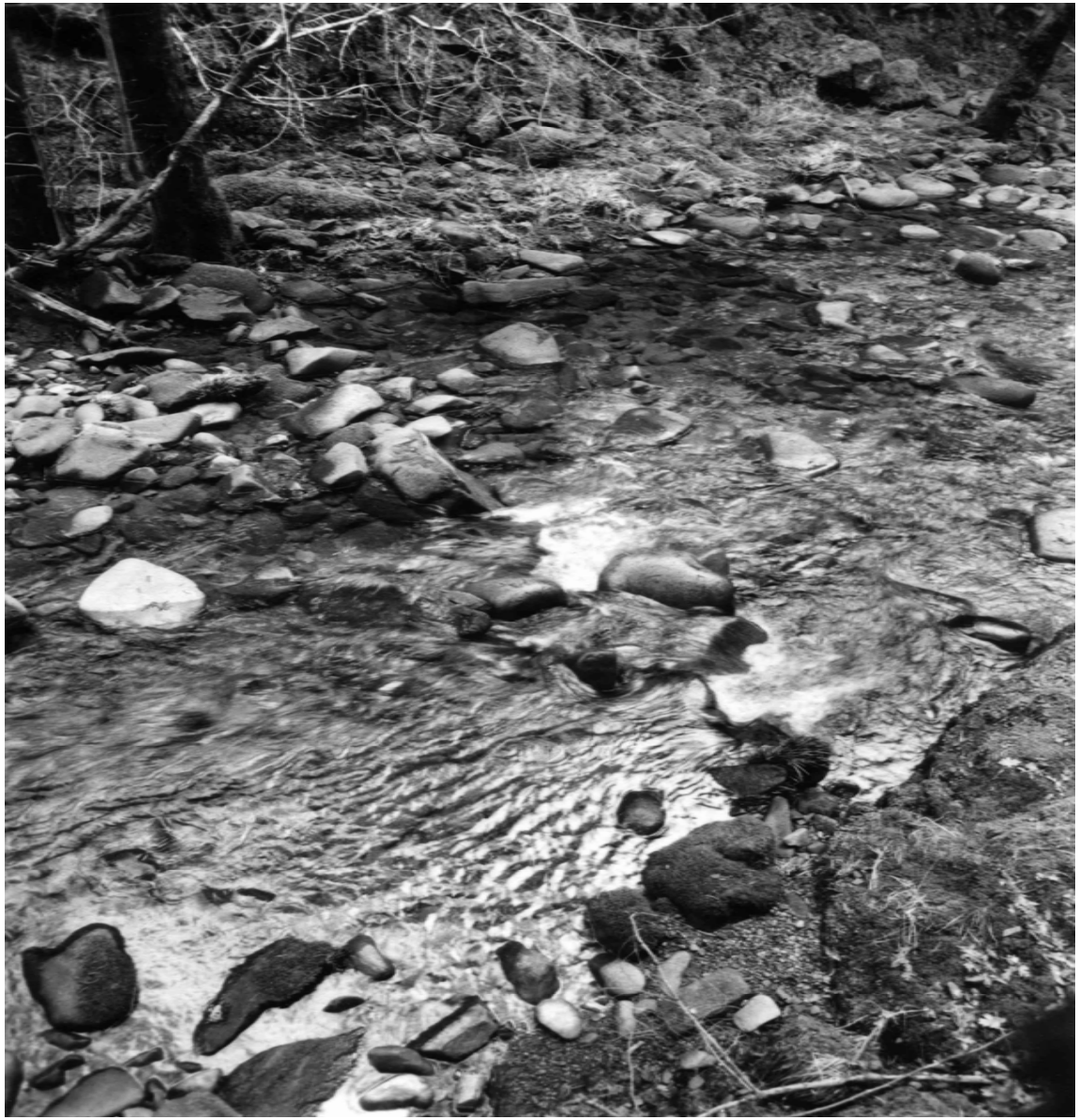

Sullivan Gulch Riffle Crest Thalweg Depth Surveys WY1999 and WY2000
(Drainage Area = 2.35 mi2)
Streamflow Depth at Riffle Crest Thalweg (ft)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Cumulative Frequency (%)
Streamflow (cfs)
95.81
82.97
53.88
29.96
29.17
17.80
3.71
1.95
1.35
0.95

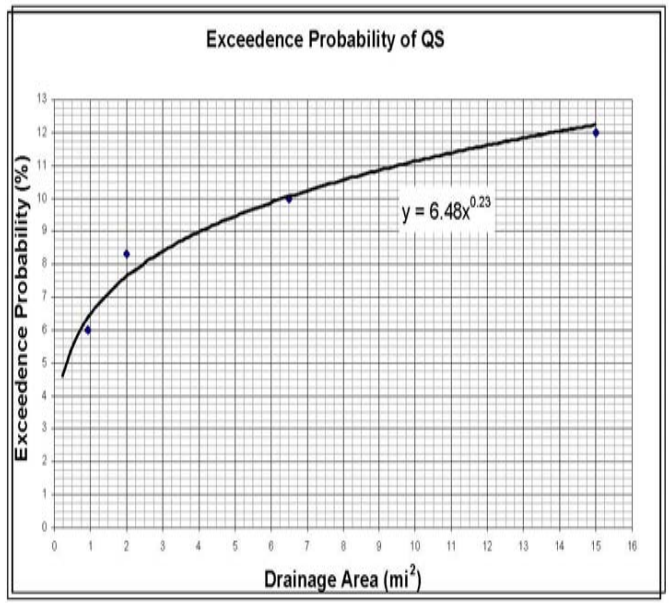
SULLIVAN GULCH
(Drainage Area = 2.35 mi^2 at Stream Gage)

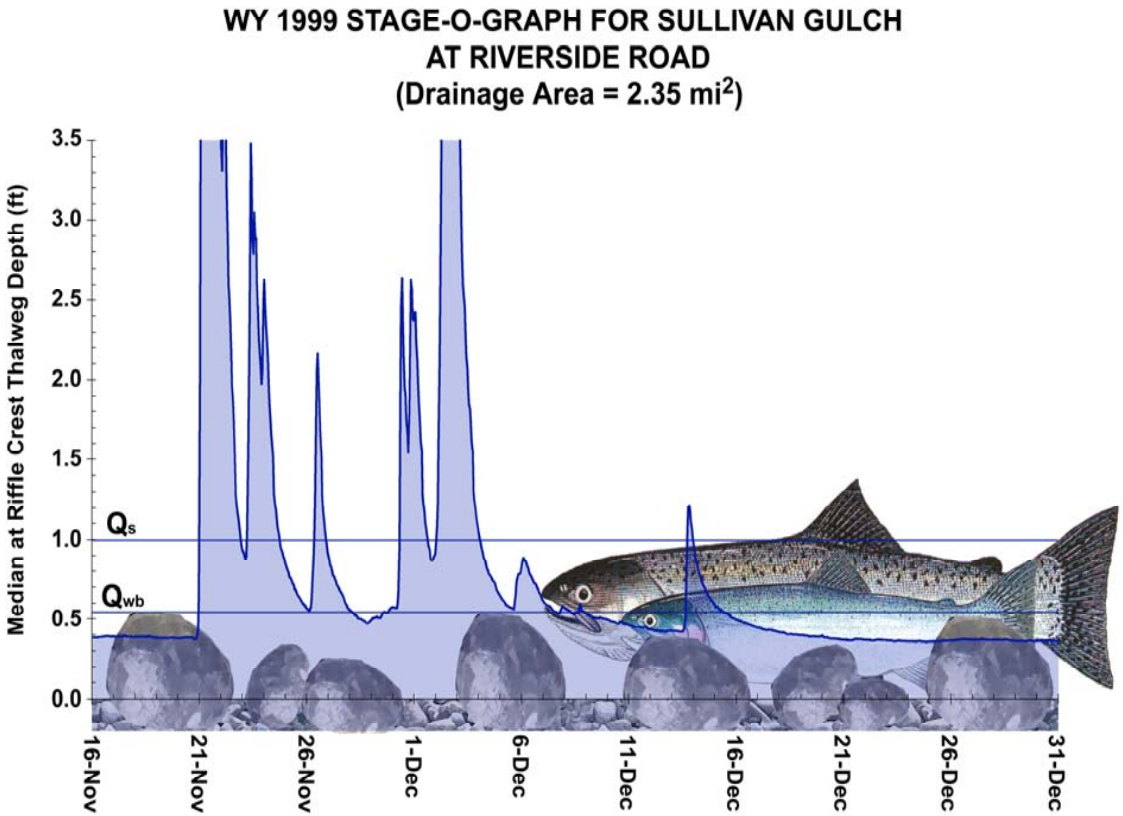


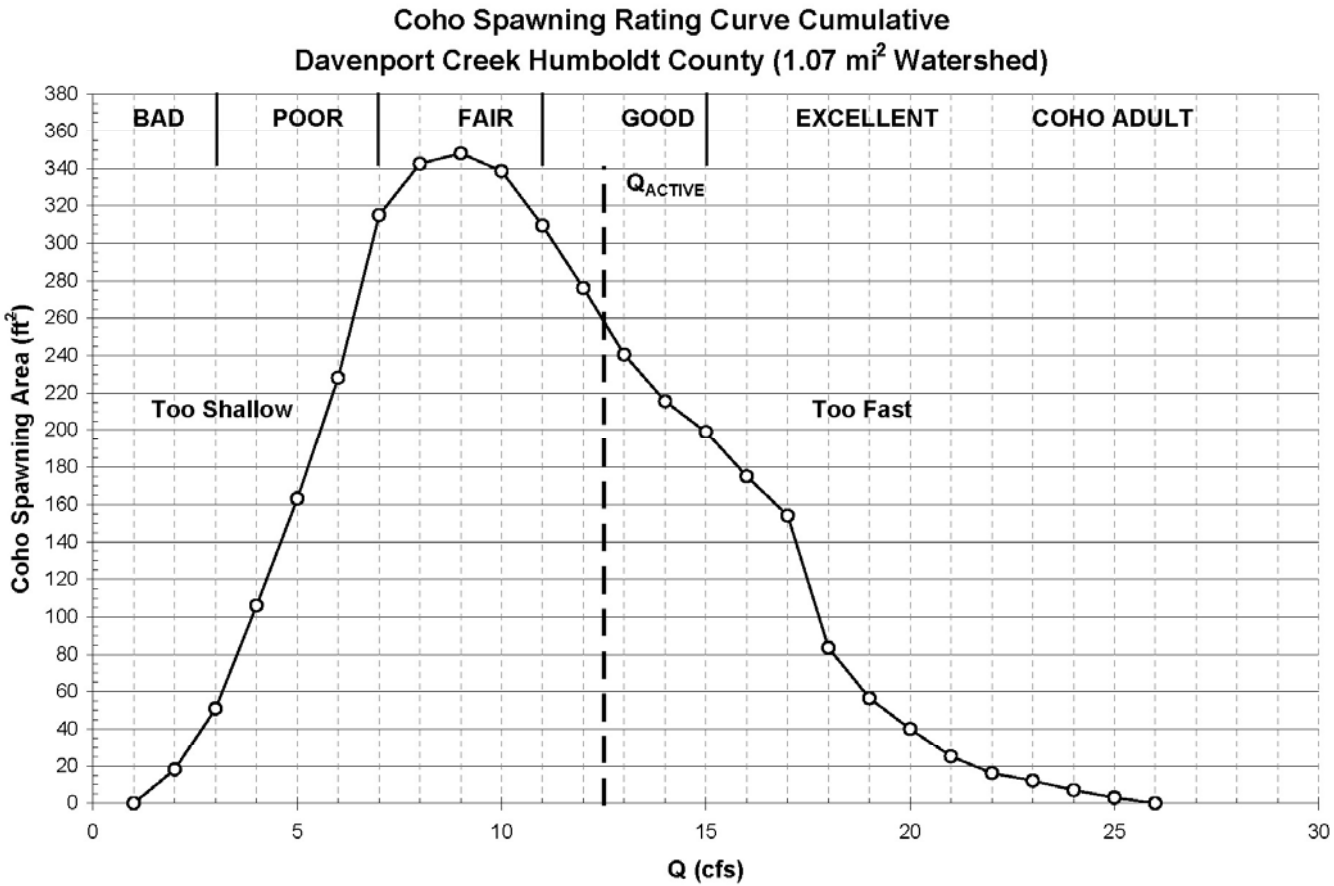
DAVENPORT CREEK
(Drainage Area = 1.07 mi^2 at Stream Gage)

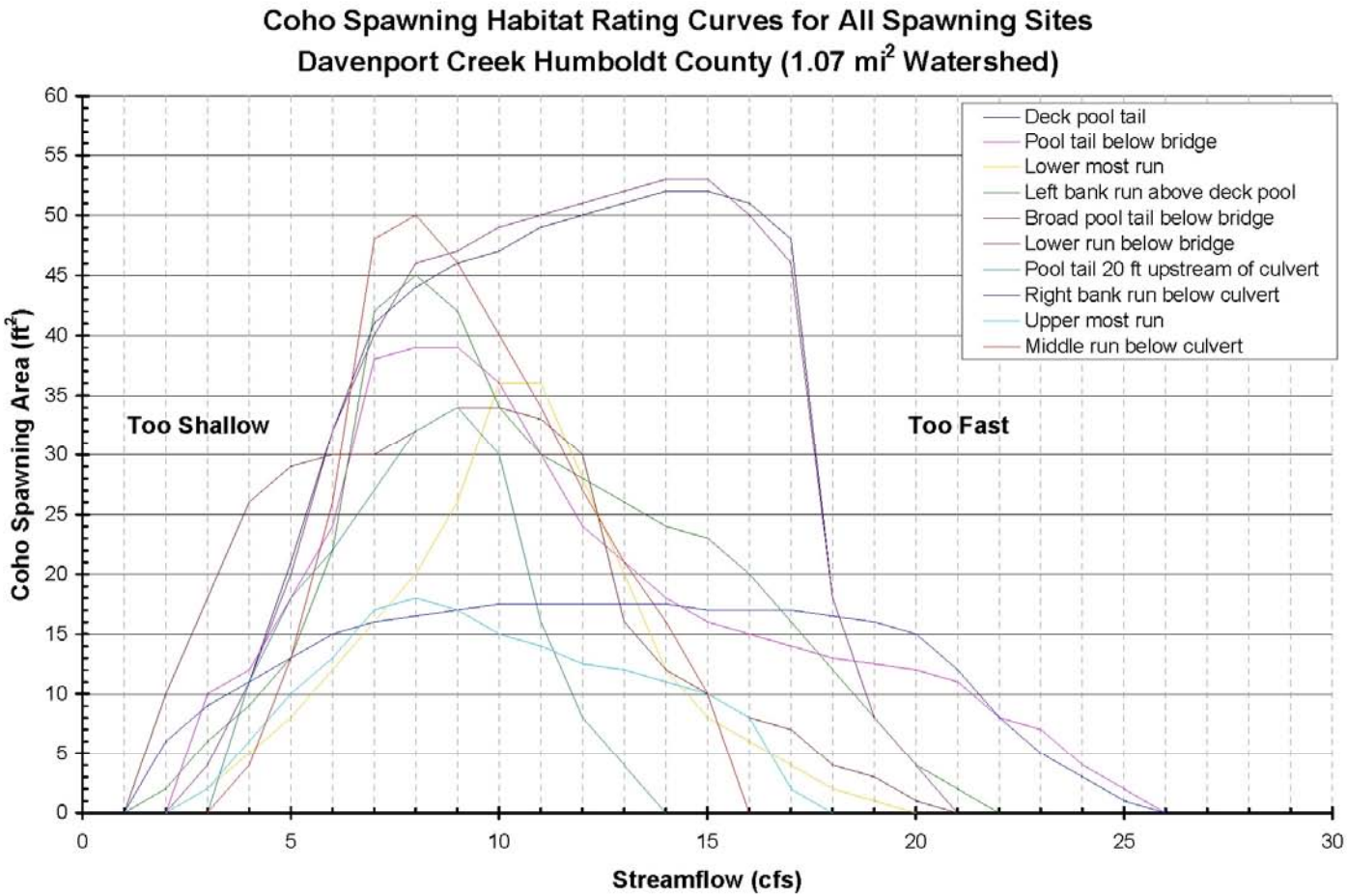





Exceedence Probability of QS
Exceedence Probability (%)
Drainage Area (mi2)
y = 6.48x0.23
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16


WY 1999 STAGE-O-GRAPH FOR SULLIVAN GULCH
AT RIVERSIDE ROAD
(Drainage Area = 2.35 mi2)
Median at Riffle Crest Thalweg Depth (ft)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Qs
Qwb
16-Nov
21-Nov
26-Nov
1-Dec
6-Dec
11-Dec
16-Dec
21-Dec
26-Dec
31-Dec


Coho Spawning Rating Curve Cumulative
Davenport Creek Humboldt County (1.07 mi2 Watershed)
BAD
POOR
FAIR
GOOD
EXCELLENT
COHO ADULT
QACTIVE
Too Shallow
Too Fast
Coho Spawning Area (ft2)
Q (cfs)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
0
5
10
15
20
25
30

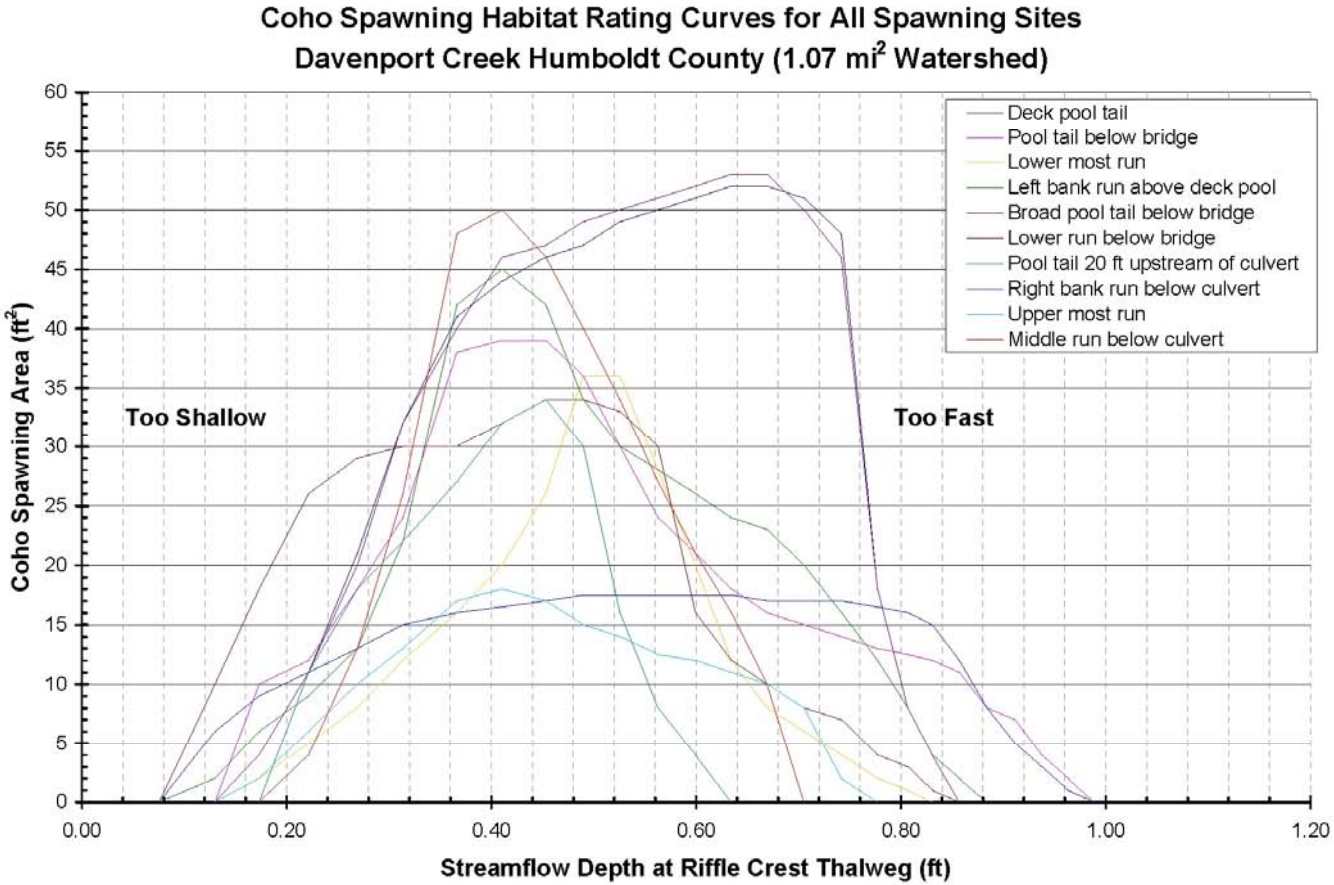

Coho Spawning Habitat Rating Curves for All Spawning Sites
Davenport Creek Humboldt County (1.07 mi2 Watershed)
Coho Spawning Area (ft2)
Streamflow (cfs)
Too Shallow
Too Fast
Deck pool tail
Pool tail below bridge
Lower most run
Left bank run above deck pool
Broad pool tail below bridge
Lower run below bridge
Pool tail 20 ft upstream of culvert
Right bank run below culvert
Upper most run
Middle run below culvert
0
5
10
15
20
25
30
35
40
45
50
55
60

Coho Salmon Spawning Habitat
@ 17, 15,11, and 7 cfs

Davenport Creek @ 15 cfs
median RCT depth = 0.62 ft

Davenport Creek @ 11 cfs
median RCT depth = 0.52 ft

Davenport Creek @ 7 cfs
median RCT depth = 0.38 ft


Coho Spawning Habitat Rating Curves for All Spawning Sites
Davenport Creek Humboldt County (1.07 mi2 Watershed)
Coho Spawning Area (ft2)
Streamflow Depth at Riffle Crest Thalweg (ft)
Too Shallow
Too Fast
Deck pool tail
Pool tail below bridge
Lower most run
Left bank run above deck pool
Broad pool tail below bridge
Lower run below bridge
Pool tail 20 ft upstream of culvert
Right bank run below culvert
Upper most run
Middle run below culvert
0
5
10
15
20
25
30
35
40
45
50
55
60
0.00
0.20
0.40
0.60
0.80
1.00
1.20

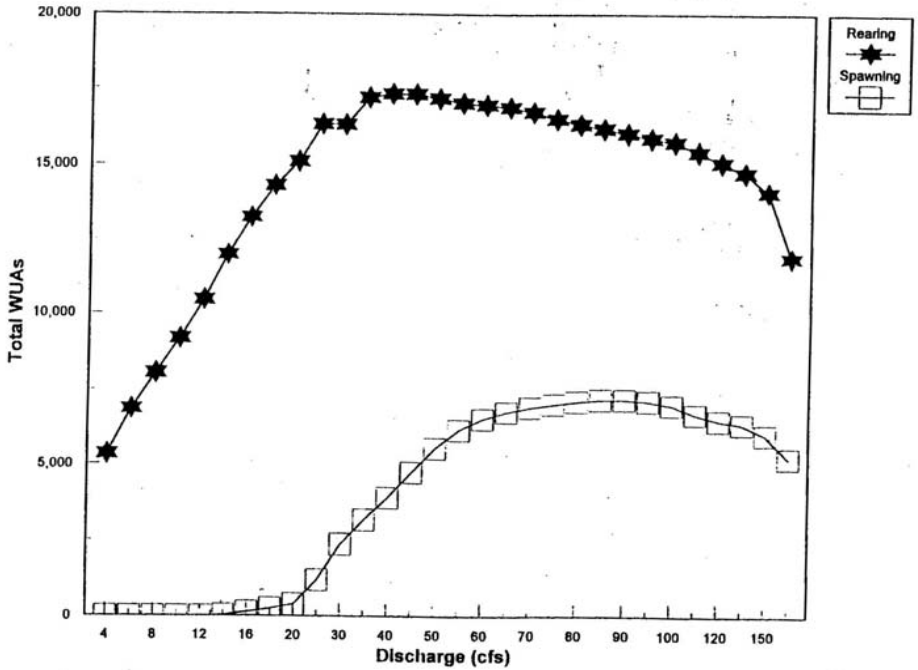
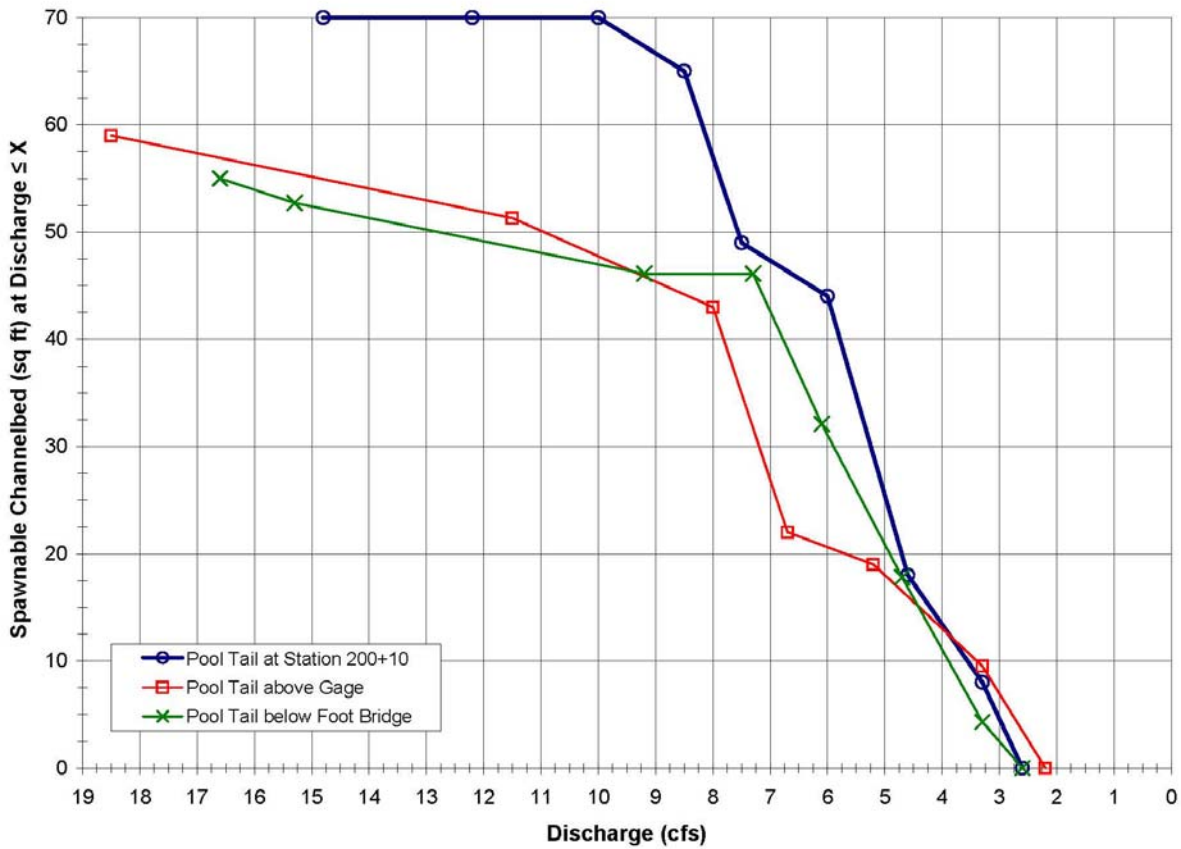
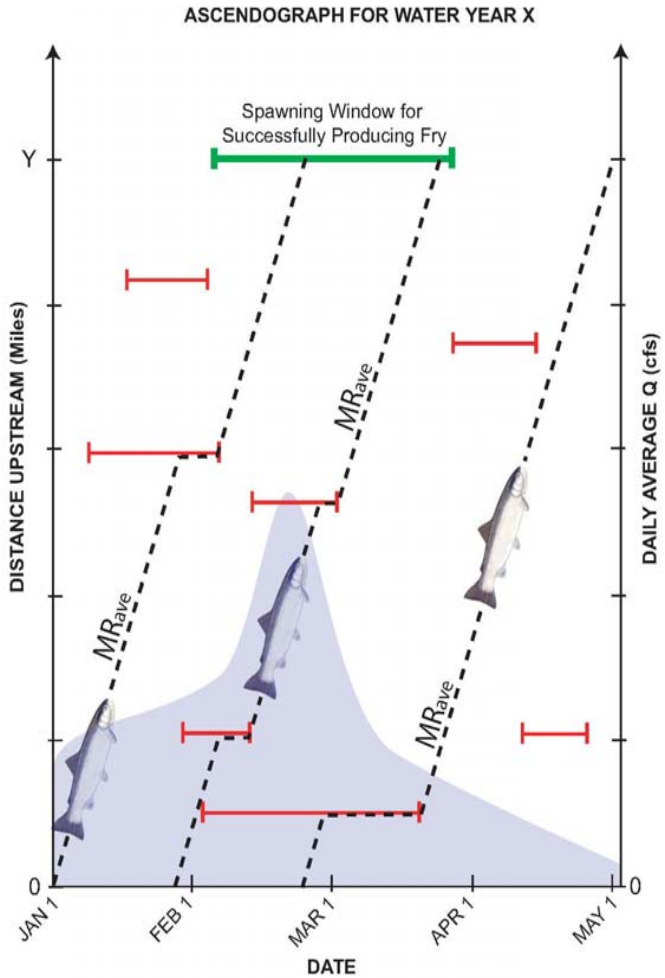


Figure 4.1-1: Total Weighted Usuable Area vs. Discharge at Little Sulphur Study Site on Big Sulphur Creek (Source: Harding Lawson Associates, 1990)

Figure 3. Weighted Usable Area curve for rearing and spawning habitat in one reach of Big Sulphur Creek, reprinted from Figure 4.1-1 in SWRCB (1997).

Spawning Opportunity Curves

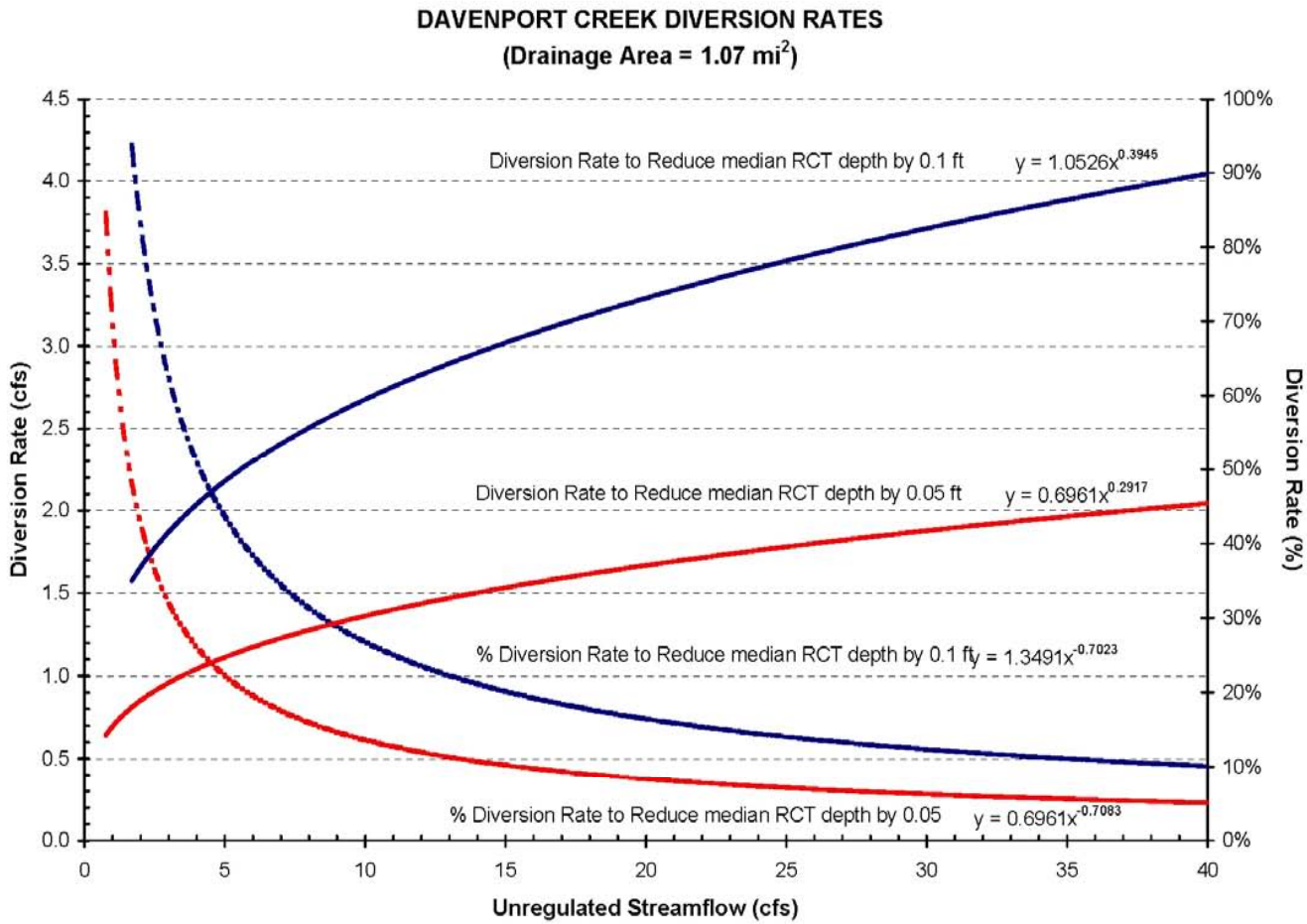


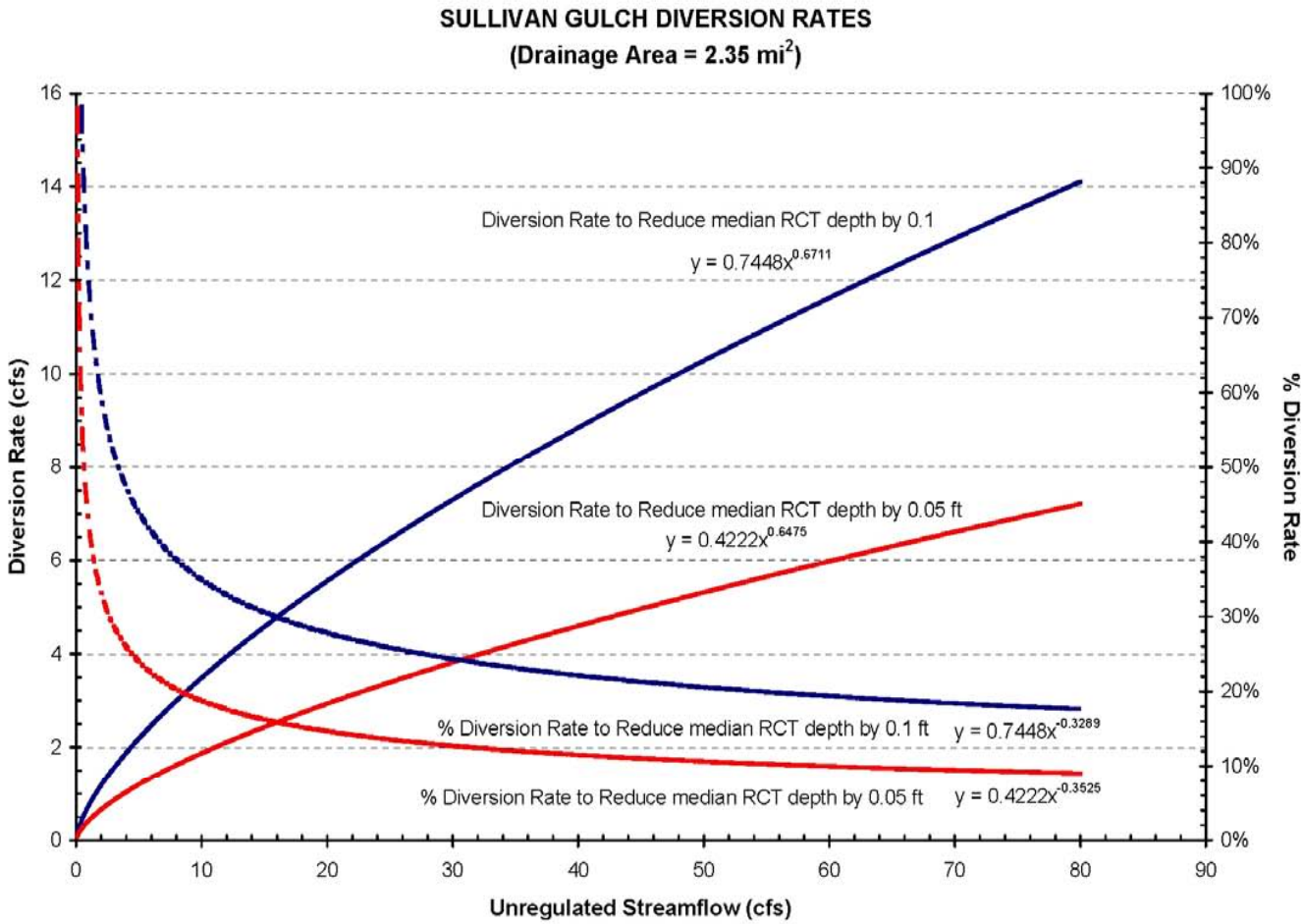


MR_{ave} = Average Adult Migration Rate for WY X (River Miles / Day)
Y = Spawning Destination
Spawning Window for Successfully Producing Fry
Barrier - Days with Flow Outside Passage Flow

Davenport Creek @ 7 cfs

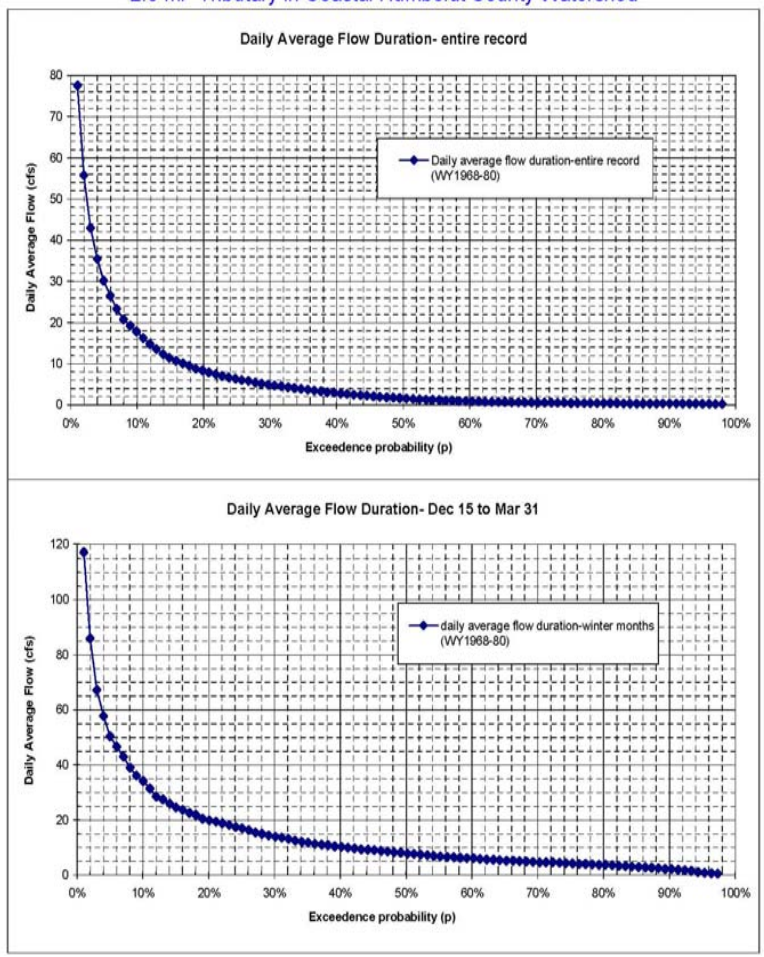
Oblique Bar


DAVENPORT CREEK DIVERSION RATES
(Drainage Area = 1.07 mi2)
Diversion Rate to Reduce median RCT depth by 0.1 ft
y = 1.0526x0.3945
Diversion Rate to Reduce median RCT depth by 0.05 ft
y = 0.6961x0.2917
% Diversion Rate to Reduce median RCT depth by 0.1 ft
y = 1.3491x-0.7023
% Diversion Rate to Reduce median RCT depth by 0.05
y = 0.6961x-0.7083
Diversion Rate (cfs)
Diversion Rate (%)
Unregulated Streamflow (cfs)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
0
5
10
15
20
25
30
35
40

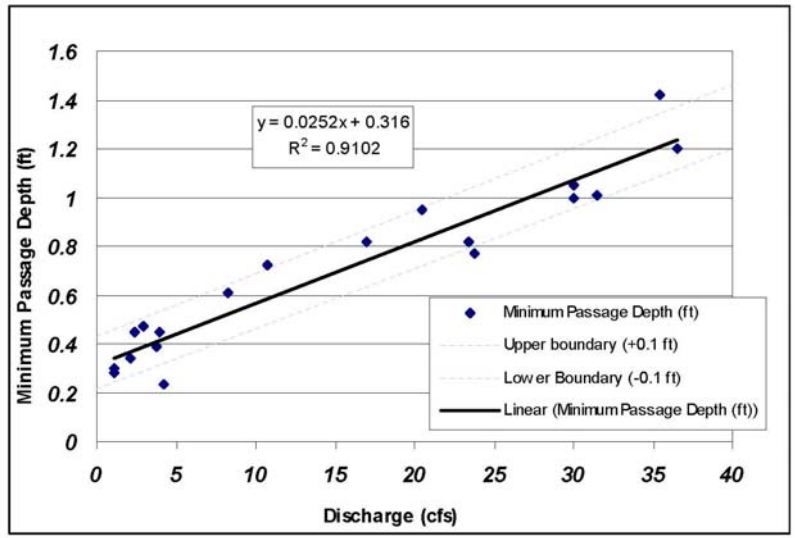

SULLIVAN GULCH DIVERSION RATES
(Drainage Area = 2.35 mi2)
Diversion Rate (cfs)
% Diversion Rate
Unregulated Streamflow (cfs)
Diversion Rate to Reduce median RCT depth by 0.1
y = 0.7448x0.6711
Diversion Rate to Reduce median RCT depth by 0.05 ft
y = 0.4222x0.6475
% Diversion Rate to Reduce median RCT depth by 0.1 ft y = 0.7448x-0.3289
% Diversion Rate to Reduce median RCT depth by 0.05 ft y = 0.4222x-0.3525
0
2
4
6
8
10
12
14
16
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
0
10
20
30
40
50
60
70
80
90

Elder Creek Coarse Riffle
DA = 6.5 mi^2

2.0 mi^2 Tributary in Coastal Humboldt County Watershed



Mean Annual Flow =	*7.1 cfs*
60% Mean Annual Flow =	*4.2 cfs*
10% Exceedence Flow =	*17.8 cfs*
Median February Flow =	*7.7 cfs*
Winter (Dec 15-Mar 31) 20% Exceedence Flow =	*19.8 cfs*
Winter (Dec 15-Mar 31) 40% Exceedence Flow =	*10.2 cfs*



Linear relationship between stream discharge (cfs) and average minimum passage depth (MPD)(ft) at riffles and runs in selected Northcoast California stream channels. This linear relationship (r2=0.91) can be used to calculate an MPD for migrating salmonids independent of drainage area. The +0.1 ft and –0.1 ft bands account for most influences of local channel morphology.

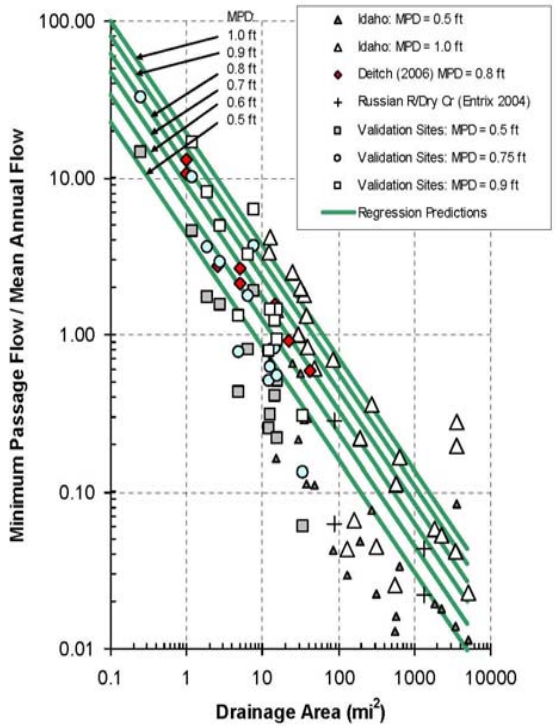


Figure E-2. Comparison of regression predictions for minimum upstream passage flow based on the data presented in Figure E-1, scaled by mean annual flow and plotted against drainage area. The prediction lines for selected minimum passage depth (MPD) criteria are indicated by arrows.

Sullivan Gulch

DA = 2.35 mi^2

QAVE = 7.52 cfs [Mean Daily Average Q]

QFEB = 9.40 cfs [NMFS/CDFG Median February Q]

QWB = 8.00 cfs [Winter Base Q w/Riffle Substrate D84 = 0.55 ft]

QMBF4 = 21.8 cfs [SWRCB LowerMinBaseQ]

QS = 36.0 cfs [Spawning Migration Q for Chinook Salmon 1.0 ft deep at Median Riffle Crest Thalweg (RCT)]

QMBF3 = 46.9 cfs [SWRCB UpperMinBaseQ]

Qfp = 78.4 cfs [SWRCB MinFishPassage Q w/ 1.0 ft depth]

QBF = 188 cfs [1.5-yr Bankfull Flood]

[5% QBF = 9.4 cfs SWRCB DivRate abv. QMBF]

Q20% = 23.5 cfs [NMFS p = 20% winter exceedence]

[15% Q20% = 3.5 cfs DivRate abv. QFEB]

QACT = 23 to 26 cfs [Active Channel Q: AnnExceed(p) = 8%]

Davenport Creek

DA = 1.07 mi^2

QAVE = 3.42 cfs [Mean Daily Average Q]

QFEB = 4.82 cfs [NMFS/CDFG Median February Q]

QWB = 5.52 cfs [Winter Base Q w/Riffle Substrate D84 = 0.30 ft]

QMBF4 = 17.6 cfs [SWRCB LowerMinBaseQ]

QS = 20.4 cfs [Spawning Migration Q for Coho Salmon 0.8 ft deep at Median Riffle Crest Thalweg (RCT)]

QMBF3 = 31.1 cfs [SWRCB UpperMinBaseQ]

Qfp = 39.3 cfs [SWRCB MinFishPassage Q w/ 0.8 ft depth]

QBF = 80 cfs [1.5-yr Bankfull Flood]

[5% QBF = 4 cfs SWRCB DivRate abv. QMBF]

Q20% = 12.4 cfs [NMFS p = 20% winter exceedence]

[15% Q20% = 1.86 cfs DivRate abv. QFEB]

QACT = 12 to 14 cfs [Active Channel Q: AnnExceed(p) = 6.5%]

QPASS = 10 to 12 cfs [Transition: Fair to Good Adult Passage]

Coho Salmon Spawning Habitat

Davenport Creek (1.07 mi^2)

Streamflow = 15 cfs

Streamflow = 11 cfs

Streamflow = 7 cfs

DAVENPORT CREEK
(Drainage Area = 1.07 mi^2 at Stream Gage)