STREAM INVENTORY REPORT

South Fork Bear Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on South Fork Bear Creek. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in South Fork Bear Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species. There is no known record of adult spawning surveys having been conducted on South Fork Bear Creek.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for chinook salmon, coho salmon and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

South Fork Bear Creek is tributary to Bear Creek, tributary to the Mattole River, located in Humboldt County, California. South Fork Bear Creek's legal description at its confluence with North Fork Bear Creek is T04S R01E S09. The confluence location is 40°07'35" North latitude and 124°03'41" West longitude. South Fork Bear Creek is a second order stream and has approximately 13 miles of blue line stream according to the USGS Ettersburg, Honeydew, and Shelter Cove 7.5 minute quadrangles. South Fork Bear Creek drains a watershed of approximately 8.6 square miles. Summer base flow is approximately 1.5 cubic feet per second (cfs) at the mouth, but over 25 cfs is not unusual during winter storms. Elevations range from about 940 feet at the mouth of the creek to 2,100 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is primarily owned by the Bureau of Land Management and is managed for recreation. Vehicle access exists from the Shelter Cove Road via Horse Mountain Road in the Kings Range National Conservation Area. Go north approximately 6.5 miles to an old skid road on the right. Follow the skid road to the mouth of South Fork Bear Creek.

METHODS

The habitat inventory conducted in South Fork Bear Creek follows

the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). The Pacific Coast Fisheries, Wildlife, and Wetlands Restoration Association (PCFWWRA) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). South Fork Bear Creek personnel were trained in May, 1996, by Scott Downie and Ruth Goodfield. A two person team conducted this inventory.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 1994). All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth. Habitat unit types encountered for the first time are further measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in South Fork Bear Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope

gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity.

3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". South Fork Bear Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form (Hopelain, 1995). Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In South Fork Bear Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4). Additionally, a rating of "not suitable" (NS) (value 5) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow

separation of territorial units to reduce density related competition. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In South Fork Bear Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two respectively.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*, 1994. Canopy density relates to the amount of stream shaded from the sun. In South Fork Bear Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or deciduous trees.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In South Fork Bear Creek, the dominant composition type (options 1-4) and the dominant vegetation type (options 5-9) of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

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BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In South Fork Bear Creek fish presence was observed from the stream banks, and two sites were electrofished using one Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes: 25.4, 12.5, 4.7, 2.37, and 0.85 mm (Valentine, 1995).

DATA ANALYSIS

Data from the habitat inventory form are entered into *Habitat*, a DBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for South Fork Bear Creek include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths
- Embeddedness

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- Pool cover by cover type
- Dominant substrate in low gradient riffles
- Percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of June 24 through July 16, 1996, was conducted by Frank Humphrey and Greg Mullins (PCFWWRA). The total length of the stream surveyed was 63,155 feet with an additional 4,039 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.5 cfs on July 2, 1996.

South Fork Bear Creek is a B2 channel type for the first 9,780 feet of stream reach surveyed; an F3 channel type for the next 24,114 feet; a B3 channel type for 27,869 feet in the third reach; and reach 4 is an F3 for the remaining 1,392 feet of stream surveyed. B2 channels are moderately entrenched, moderate gradient, riffle-dominated channels with stable banks and boulder substrate. B3 channels are very similar, but the dominant substrate is cobble. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 52 to 67 degrees Fahrenheit. Air temperatures ranged from 53 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 39% riffle units, 31% flatwater units, and 29% pool units (Graph 1). Based on total **length** of Level II habitat types there were 36% flatwater units, 35% riffle units, and 28% pool units (Graph 2).

Twenty-one Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffles, 33%; runs, 22%; and mid-channel pools, 17% (Graph 3). Based on percent total **length**, low gradient riffles made up 28%, runs 19%, and mid-channel pools 15%.

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A total of 520 pools were identified (Table 3). Main channel pools were most frequently encountered at 73% and comprised 77% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Three hundred and nine of the 520 pools (59%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 520 pool tail-outs measured, 98 had a value of 1 (19%); 127 had a value of 2 (24%); 292 had a value of 3 (56%); none had a value of 4; and 2 had a value of 5 (1%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Pool habitat types had a mean shelter rating of 42, and riffle habitats had a mean shelter rating of 30 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 46. Scour pools had a mean shelter rating of 39 (Table 3).
Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in South Fork Bear Creek and are extensive. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in South Fork Bear Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 47 of the 59 low gradient riffles measured (80%). Boulder was the next most frequently observed dominant substrate type and occurred in 10% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 86%. The mean percentages of deciduous and coniferous trees were 78% and 22%, respectively. Graph 9 describes the canopy in South Fork Bear Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 73%. The mean percent left bank vegetated was 73%. The dominant elements composing the structure of the stream banks consisted of 11.2% bedrock, 21.3% boulder, 49.1% cobble/gravel, and 17.5% sand/silt/clay (Graph 10). Brush was the

dominant vegetation type observed in 28% of the units surveyed. Additionally, 55.8% of the units surveyed had deciduous trees as the dominant vegetation type, and 8.6% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on July 2, 1996, in South Fork Bear Creek. The sites were sampled by Ruth Goodfield (DFG), Kelley Garrett, and Todd Kraemer (WSP/AmeriCorps).

The first site sampled included habitat units 0093-0094, a riffle/pool sequence, approximately 4,259 feet from the confluence with Bear Creek. This site had an area of 1,000 sq ft and a volume of 600 cu ft. The site yielded seven young-of-the-year (YOY) steelhead rainbow trout.

The second site included habitat units 0174-0175, a run/pool sequence located approximately 7,857 feet above the creek mouth. This site had an area of 560 sq ft and a volume of 504 cu ft. The site yielded three YOY steelhead rainbow trout.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on South Fork Bear Creek.

DISCUSSION

South Fork Bear Creek is a B2 channel type for the first 9,780 feet of stream surveyed; an F3 for the next 24,114 feet; a B3 for 27869 feet in the third reach; and an F3 for the remaining 1,392 feet. The suitability of B2 and B3 channel types for fish habitat improvement structures is excellent for low-stage plunge weirs, opposing wing-deflectors, and log cover structures. The suitability of F3 channel types for fish improvement structures is good for bank-placed boulders; fair for low-stage weirs, boulder clusters and log cover; and poor for medium-stage weirs.

The water temperatures recorded on the survey days June 24 to July 16, 1996, ranged from 52 to 67 degrees Fahrenheit. Air temperatures ranged from 53 to 75 degrees Fahrenheit. This is an acceptable water temperature range for salmonids. However, 67° F, if sustained, is near the threshold stress level for

salmonids. This does not seem to be the case here, and South Fork Bear Creek seems to have temperatures favorable to salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 36% of the total **length** of this survey, riffles 35%, and pools 28%. The pools are relatively deep, with 309 of the 520 (59%) pools having a maximum depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

The LDA's in the system are retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the gravel out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Two hundred ninety-six of the 520 pool tail-outs measured had embeddedness ratings of 3 or 4. Only 98 had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In South Fork Bear Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was low with a rating of 42. The shelter rating in the flatwater habitats was even lower at 28. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, undercut banks contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

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Fifty-one of the 59 low gradient riffles measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 86%. This is a relatively high percentage of canopy. In general, re-vegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 73% on both banks. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) South Fork Bear Creek should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable and in some areas the material is nearby and readily available.

4) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 12,363', should then be treated to reduce the amount of fine sediments entering the stream.

5) There are several log debris accumulations present on South Fork Bear Creek that are retaining large quantities of fine sediment. The modification of some of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment transport to downstream reaches.

6) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

0'	Begin survey at confluence with Bear Creek. Channel type is a B2 for the first 9,780' of stream surveyed.
1062'	Tributary enters from left bank (LB). Temperature is 53°F.
1175'	Tributary enters from LB - 53°F.
1580'	Numerous salmonid young-of-the-year (YOY) observed from streambank.
2257'	Tributary enters from LB - 53°F. YOY observed in tributary by surveyors.
2486'	Tributary enters from LB - 53°F.
2606'	Tributary enters from LB - 53°F.
3142'	Tributary enters from LB - 53°F.
3269'	Tributary enters from LB - 53°F.
3766'	Spring on right bank (RB).
3988'	Tributary enters from RB - 53°F.
4259'	Bioinventory site #1.
4293'	Tributary enters from RB - 53°F.
5337'	Tributary enters from LB - 52°F.

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5711' Tributary enters from RB - 53°F.

5884' Spring on right bank (RB).

6009' Spring on right bank (RB).

6234' Spring on right bank (RB).

7526' Tributary enters from RB - 57°F.

7857' Bioinventory site #2. Steelhead YOY observed.

8177' Tributary enters from LB - 54°F.

9704' Spring on right bank.

9780' Channel type changes from B2 to F3 for the next 24,114' of stream surveyed.

10133' Tributary enters from LB.

10578' Spring on right bank.

10894' Tributary enters from LB - 53°F.

12363' Slide on right bank; approximately 40'L X 30'H. Contributing fines directly to the stream.

12562' Tributary enters from RB - 51°F.

14610' Tributary enters from RB - 57°F.

15478' Tributary enters from RB - 59°F.

16166' Spring on left bank.

17127' Tributary enters from RB - 54°F. Strong sulphur odor in this area of the stream.

17632' Tributary enters from RB - 56°F.

17713' Large debris accumulation (LDA) in stream - might be a barrier to fish except in high flows.

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18117' Trail to Tolkan Campground - good access to creek.

18315' Tributary enters from RB - 57°F.

18918' Spring on RB.

19149' LDA in stream - possible barrier for fish.

19606' Tributary enters from RB - 57°F.

19860' Spring on LB.

20174' LDA in stream - not a barrier to fish.

21207' Spring on LB.

21292' LDA in stream - not a barrier to fish, but could cause bank erosion and more debris build-up in the near future. Possible site for LDA modification project.

21933' Tributary enters from LB - 57°F.

22364' Tributary enters from RB - 59°F.

22599' Tributary enters from RB - 55°F.

25072' Tributary enters from RB - 57°F.

27341' Spring on left bank.

27945' Tributary enters from RB - 57°F.

28398' Tributary enters from RB - 57°F.

28786' YOY salmonids observed.

29129' LDA in stream; 20'L x 20'W x 5'H. Not a barrier to anadromous fish.

30305' LDA in stream; 20'L x 20'W x 5'H, retaining sediment. No barrier.

30641' Tributary enters RB - 57°F.

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30745' Tributary enters RB - 57°F.

31508' Tributary enters from RB 59°F. Fish observed by surveyors.

32284' Tributary enters from RB - 60°F. Fish present.

33270' LDA - 20'L x 20'W x 10'H. Not a barrier to fish.
33894' Channel type changes from F3 to B3 for the next 27,869' of stream surveyed.

35067' Railroad car bridge crosses stream - private access.

35220' Rip-rap on left bank.

35942' Rip-rap on right bank.

36404' Wooden footbridge crosses stream - private access.

36705' Spring on right bank.

37435' LDA - 15'L x 20'W x 5'H. Not a barrier to fish.

38267' Tributary enters from RB - 59°F. Fish observed by surveyors.

39950' Tributary enters from LB - 56°F.

41925' Dry tributary on RB.

42435' Tributary enters from RB - 56°F.

43202' LDA - 25'L x 15'W x 5'H. Not a fish barrier.

45636' Tributary enters from RB - 58°F.

46048' Corrugated metal culvert at Shelter Cove Road (6' diameter).

46701' Tributary enters from LB - 56°F.

47970' LDA - 10'L x 20'W x 5'H - retaining sediment. Not a barrier to fish.

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48226' Tributary enters from LB - 59°F.

49202' LDA in stream - possible barrier to fish.

49945' LDA in stream - possible barrier to fish.

50513' Tributary enters from RB - 54°F.

51463' Log structure in stream; installed by the CCC.

52845' Tributary enters from RB - 57°F.

53003' Spring on LB.

56009' Tributary enters from LB -54°F. Rearing pond in tributary.

56306' Footbridge crosses stream.

59132' Footbridge crosses stream - trail to Nadelas Campground.

59899' LDA in stream - retaining sediment. Probable barrier to fish except during high flows.

60425' Footbridge crosses stream - trail to Wailaki Campground.

61763' Channel type changes to F3 for remaining 1,392' of stream surveyed.

62318' Tributary enters from RB - 52°F. YOY salmonids observed by surveyors.

63155' Stream flow becomes intermittent. End of survey.

References

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

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Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, California.

LEVEL III and LEVEL IV HABITAT TYPE KEY

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5