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From: Coryell A. Ohlander, hydrologist

RE: Comments keyed to UFP's outline re watershed assessment and current efforts on Hydrologic Condition Assessment and Proper Functioning Condition.

Guiding principles:
2) ... accelerate improvements in water quality and watershed condition.
3) Use the results of watershed assessments to guide planning and management activities ...

Objectives 1.2. Building on current efforts, we will develop and test watershed assessment procedures in watersheds that have been delineated using the interagency guidelines.

My comments regarding the strong need for the agencies involved to fully understand the legislative mandates were expressed before and will not be repeated here. But it is essential to develop the most demanding requirements as a foundation for watershed assessment. It is also important for the agencies not to make up policy that is outside the legal mandates; or to ignore policy that is already in place and under the auspices of legislative mandate. Or to assume a leadership role that is legally designated for other agencies.

I am delighted to see the basic framework for cooperative watershed assessment put into policy. One major road block to attaining a watershed accounting system for land and water conditions and aquatic health has been the tremendous number of ways in which it can be done. The literature is nearly afloat with analytical processes and procedures that get at various parts of the problem; but not much systematic or comprehensive analyses that deals with the totality of watershed conditions or the problems of S305 & S319 accounting. It is sort of like drilling for oil with 1000 holes, each of which is 10 feet deep. If UFP can pull this off, you have my greatest respect.

Current experience suggests that the lack of a comprehensive approach is mainly the result of insufficient commitment to get the job done and keep up with the detail. However, the problem is also due to the perspective at which watersheds are viewed. For example, planning questions that center around the economics of water yield and geomorphic equilibrium favor a BIG BUCKET analysis with little or no analysis of distributed effects. This approach lends itself to the display of gross effects, thresholds of concern, and a variety of watershed screening criteria that do not require site specific information.

There is a second level of analysis that involves the distribution of risk (hazards) and effects in both time and space; it is the "dipper" in the BIG BUCKET analog. A typical dipper frame of reference would be sites that fail to meet stewardship levels of soil and water protection. Often such sites become severely damaged before they are treated and effects on the BIG BUCKET largely ignored because program control and the budget process tends to shift treatment randomly from watershed to watershed fixing a few acres here and there.

Both the Federal and State agencies have treated the BIG BUCKETS and the dippers as unrelated and separate issues; just as there is no accounting system to formally link watershed condition, site recovery, and stream health together. Laws such as S319 that do so are largely ignored. It appears that UFP is now intending to stress that both levels of analysis are needed in the same loop; that the mandates for land productivity and stream health protection are entwined with NEPA cumulative effects analysis and State water quality reporting requirements; and that the sum total reflect a tough legal framework that actively joins the BIG BUCKET and the dipper. The UFP addresses this as a real question - something the individual agencies, including EPA's 319 program, have been unwilling to do.

The UFP makes a point of watershed stakeholders. Yes, there are stakeholders; but they are <u>Distributed Stakeholders</u>. The streams of streams of streams of streams leading to the one you can hop across are still waters of the U.S. and are covered

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by CWA. And there are people everywhere with concerns about those streams. The number of watershed related organizations that have sprung up over the last 10 years is merely a taste of the future. Many laws including CWA and SDWA promote these local watershed groups and provide them with substantial power.

Given the distribution, the debate about the size of watershed at which to do ``cumulative effects'' is a non-starter. There are cumulative effects at all watershed levels; the question is one of summary - at what level do you provide accounting. We know that it is not appropriate to shift evaluation to the mouth of the watershed and proclaim, that because the main channel shows no effects, that there are, in fact, no effects. We know this is not appropriate for watershed cumulative effects under NEPA nor for reports under CWA S303d, S305b, or S319; nor does it address the NFMA viable population question or ESA conservation strategies for aquatic species. Nor is it workable at the local level in dealing with local watershed groups.

In my first letter, I put forth the notion that UFP should strive for the most demanding watershed reporting covered by law, which, in my opinion, is S319. From an information summary or public display the watershed would be the ``5th'' code HUC's with the data base capable of sorting out to both higher and lower HUC levels. For a Forest Plan, a 5th level gives you about 50 - 150 watersheds - which is about all one would ever want in a Forest Plan. The State needs to be able to aggregate the information into 4th level hydrologic units; and for some assessments such as for viability of aquatic species, up to 3rd level HUC's.

Stream health maps are essential and can be generated at reasonable cost by experienced people. Such maps reflect the endpoints or results of current and past watershed activity. I would like to see UFP adopt 1:24000 map scale as a minimum standard at which stream health data is tabulated and constructed as a complement to USF&WS 1:24000 wetlands maps. But it is a minimum; S404 type questions often trigger map scales down to 1:10000. Also at a minimum, the maps should display EPA's 6 aquatic health classes.

In pursuit of S319, the Watershed Water Quality Assessment Summary was built to accommodate a tabulation of activities and EPA's 6 aquatic health classes on the same platform. Stream health then is a bottomline expression of watershed condition with detail about the effectiveness of pollution control measures applied by activity - namely ``Safeguarded, At-risk, or Failure.'' For the most part these are defined in relation to runoff from design storms (i.e. 10yr24hr).

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WATERSHED WATER QUALITY ASSESSMENT - Summary

HUC Cat #:	NFS Wshed#:		Date:____________
Natl For:	District:	Watershed:	
Management Situation:		Progm Officer:	

Stream Health Watershed Summary

	Total miles	NFS miles	(class, CWA stream miles, comments) Project Status (monitoring or restoration plans)
Robust	: mi	mi	
Adequate	: mi	mi	
Diminished	: mi	mi	
Impaired	: mi	mi	
Precarious	: mi	mi	
Catastrophic	: mi	mi	

Watershed Summary - Water Pollution Sources

Land & Water Operations	unit	Total Quantity	National Forest System Lands Quantity	Safeguard	At-Risk	Failure
Geophysical Modification						
Agriculture	ac					
Corridors	mi					
Deforestation	ac					
Heavy use sites	ac					
High hazard lands	ac					
Mining, milling, & mfg sites	ac					
Roads & trails	mi					
Silviculture	ac					
Water collection/transfer	mi					
Water storage surface	ac					
Wetlands & Riparian altered	ac					
Chemical Contamination						
Bulk transport routes	mi					
Energy production sites	ea					
Land use application	ac					
Natural non-point	ac					
Point sources	ea					
Residue disposal - tox/haz/rad	ea					
Solid waste landfill	ea					
Tailings & Spoil banks	ac					

=2/98

UFP should establish NRCS's Runoff Curve Numbers (RCN) as a minimum standard way to describe land and vegetation conditions. There are several very practical reasons for doing so - not the least of which is that so much of the NPDES & SDWA regulatory framework leads in that direction, anyway. The following tables, Table C re Stormwater Runoff and Table D Safe Drinking Water Act requirements both show runoff related estimates that can come from RCN methods.

RCN's also provides a foundation for the evaluating ''hydrologic condition'' found in EPA's S304 guidance for silviculture (1973) and range management (1979). Several FS regions use an evaluation of high runoff areas such as Equivalent Road Area or Equivalent Disturbed Area - which can be derived from RCN.

Table C -- Stormwater Runoff Data & Analysis -- CWA S 402(p)
(CWA 40 CFR 122 Stormwater Discharge NPDES)

Section		Minimum Requirements	Response	Notes	
40 CFR 122.26		Storm water discharge (NPDES related)			
(c)(1)	=	applications INDIVIDUAL.	FFCP	FSen	
ii	=	Construction (122.26(b14(x))	FFCP	FSen	
		Name of receiving water	FFCP	FSen	
		map & location (1:10000 to 1:24000 topo)	SDEQ	RRF_	
		nature of activities and area disturbed	ROD		
		construction & post constructn contl measures	ROD		
		Best Management Practices	ROD		
		local erosion & sediment control reqrmt	ROD	PLAN	
		estimate of runoff coefficient	ROD	PLAN	
		estimate of impervious area increases	ROD	RCN	2-12
		nature of the fill material (describe soil)	ROD	RCN	2-12
(c)(2)	=	applications as group GENERAL permit	ROD		
i	=	Applicants, activities, abatement, support data	PLAN		
(d)(1)	=	Municipal (med & large) (Part 1)	PLAN		
iii B	=	sources: map (7.5' 1:10000 to 1:24000)	2542	problem 11	
2		land use existing & next 10 years	IRI	WWQA	
		include runoff coeff for each land use	WWQA	PLAN	ROD
3		operating & closed landfills & disposl sites	RCN		
4		location & # of NPDES permits	WWQA	PLAN	
iv	=	Discharge characterization	SDEQ		
A	=	mean monthly ppt & number of storm events	SDEQ		
B	=	outfalls -- volume & quality (list sample pts)	SDEQ		
C	=	water body list receiving discharges (S 319)	SDEQ		
D	=	Field screen (odor, oil, scum, turbidity)	SDEQ		
		population, traffic & road density	WALK		
		age of structural works, history, land use	SDEQ	PLAN	
v	=	Mgt programs to control pollution	SDEQ	PLAN	
(d)(2)	=	Part 2 of Municipal Applicatn	SDEQ	S&G	PLAN
		interagency agreements	2542	problem 14	
ii	=	Source identification.	2542		
iii	=	Characterization data: ''quantitative data'' Inventory by watershed:	SDEQ	WWQA	
A	=	drainage area, location & # of outfalls	LOAD	FSstudy	
iv	=	Impose controls on a ... watershed basis ...	SDEQ	WWQA	
A	=	structural and source control	SDEQ	WWQA	
		maintenance activities & schedules	SDEQ	S&G	
		identify planning process to reduce polltnt	S&G		
		construction site pollution control	NFMA	PLAN	MOU
		public streets, roads, highways.	ROD	S&G	PLAN
		procedures to reduce stream impacts	S&G	FSen	PLAN
		de-icers, pesticides, herbicides, fert	WWQA	WWQM	

B =	pipe flush, land irrigation, stream diversion	SDEQ S&G WWQA
	rising ground water,	SDEQ
	uncontaminated ground water infiltration	SDEQ
	flows from riparian habitats and wetlands	PLAN
	procedures for on-site field screening	WALK
	emergency response to spills	EMER
C =	landfills, disposal, RCRA, SARA	EPA SDEQ WWQA
D =	maintain structural & nonstructural BMP's	S&G PLAN WALK

Table D - Safe Drinking Water Act Requirements
(Public Health Service Act, Title XIV. 42 U.S.C. 300f-300j-26)

Section	Minimum Requirements	Response Notes
300f	Definitions	
	public water system: (15 connections or 25 people)	2542
	Rural Water Survey - (quan, qual, & avail; SecAg)	PLAN compare
300g-2	State primary enforcement responsibility	SDEQ
	(a) monitoring and records	SDEQ FSen
300g-3	Enforcement of drinking water regulations	SDEQ
	(f) earliest feasible time	EMER
	maximum feasible protection	EMER PLAN
300h-6	Sole source aquifer demonstration program	SDEQ
	(a) protect critical aquifer protection areas	SDEQ 2542 PLAN
	(b) ground water quality protection plan (CWA S 208)	SDEQ PLAN
	(d) criteria:	SDEQ EPA
	vulnerability	WWQA WWQM
	population using a ground water source	2542 PLAN
	comprehensive mgt plan for critical protection area	2542 PLAN
	natural vegetative and hydrogeological conditions	NFMA PLAN
	ground water flow, recharge, and discharge	GEOL problem 12
	existing anthropogenic contaminant sources	WWQA SDEQ
	potential anthropogenic contaminant sources	WWQA WCE NEPA
	detailed map of boundaries	IRI PLAN
	point and nonpoint sources of degradation	TSTD WWQA WIN
	relationship of activities to ground water quality	problem 13
	practices to be implemented	WWQA PLAN ROD
	authorities to implement	SDEQ PLAN ROD
	special protection area watershed	2542 PLAN ROD
	federal activity contribution to degradation	TSTD WWQA WWQM
	'' '' '' '' infiltration loss	WWQA WWQM RCN
	emergency contingency planning	PLAN EMER
	no adverse impacts on WQ & recharge capabilities	S&G PLAN WALK
	pollution abatement measures	SDEQ WWQA WIN
300h-7	State programs to establish wellhead protection areas	
	(a) wellhead protection area	2542 PLAN ROD
	(h) compliance - federal agencies with jurisdiction	S&G PLAN
	(i) oil and gas well injection	SDEQ WWQA S&G
	(j) coordination with water rights	PLAN
300j-1	Research, technical assistance, information, training	
	(a) sources of such contamination	WWQA problem 13
	sources of water supplies	2542
	responding to emergency situations	EMER WALK
	abandoned injection or extraction wells	WWQA WWQM
	pesticides and fertilizers	WWQA WWQM
	surface contaminants - pools, pits, lagoons, ponds	WWQA WWQM
300j-4	Records and inspections	Sreq FSen MOU
	(b) including raw water sources	problem 14
300j-9	(h) report each year	SEDQ PLAN MOU
300j-13	Source water quality assessment (1996 amdmts)	WWQA SDEQ PLAN

Runoff Curve Numbers is not new technology and is already in place with many sources and application. A list of commonly referenced hydrology handbooks that include forest and range related runoff curve numbers include:

Barfield, B.J., R.C. Warner, and C.T. Haan. 1983. Applied hydrology and sedimentology of disturbed lands. Okla Tech Press. Stillwater OK.603p.

Chow, Ven Te. ed. 1964. Handbook of Applied Hydrology. McGraw Hill. 1000+p.

Daddow, Richard L. 1986. SEDIMOT II Computer model - Introduction and application on National Forest Lands. Transmitted by David G. Unger, Director of Watershed and Air Management, Forest Service, Wash DC.

Dunne,T. and Luna B. Leopold. 1978. Water in environmental planning. W.H. Freeman & Co. New York. 818 pg.

U.S. Bureau of Reclamation. 1977. Design of small dams. Wash DC. 816pgs.

U.S. Soil Conservation Service. 1985. Hydrology. Sec. 4 National Engineering Handbook. (Updates of material dated 1964 to 1972.) Wash DC. 500± pgs.

U.S. Soil Conservation Service. 1986. Urban hydrology for small watersheds. Engineering Div. Technical Release 55. Wash DC. 200± pgs.

Wilson, B.N., B.J. Barfield, and I.D. Moore. 1983. A hydrology and sedimentology watershed model - SEDIMOT II. Part 1 Modeling Techniques. Dept of Ag. Engineering, Univ. of Kentucky. 200 pgs

Warner, R.C., B. Wilson, B.J. Barfield, D.S. Logsdon, and P.J. Nebgen. 1983. A hydrology and sedimentology watershed model - SEDIMOT II. Part 2: User's Manual. Dept of Agricultural Engineering, Univ. of Kentucky. 200 pgs

U.S. Dept of Agriculture. 1995. Water Erosion Prediction Project (WEPP) User Summary. Computer model. (Flanagan DC & SJ Livingston, eds). USDA-ARS Natl Soil Erosion Research Lab, NSERL Report 11. 131p.

U.S. Dept of Agriculture. 1995. Water Erosion Prediction Project (WEPP) Technical Documentation for WEPP Computer model. (Flanagan DC & MA Nearing, eds). USDA-ARS Natl Soil Erosion Research Lab, NSERL Report 10. 286p.

U.S. Dept of Agriculture. 1995. Wind Erosion Prediction System (WEPS) Technical Documentation. July computer model Beta release 95-08. (Hagen LJ, ed). USDA-ARS NPA, Wind Erosion Research Unit, Kansas State Univ. 261p.

USDA WEPP 1995, (p7.27), tech. document concludes WEPP hydrology gives a "slightly better fit" than does RCN (but no difference statistically). WEPS 1995 hydrology submodel (Chapter H) uses RCN method because it is reliable, computationally efficient, uses readily available data, and relates runoff to soil properties, soil moisture, hydrologic conditions of the ground cover, land use, and management practices (page H-4). In WEPS, corrections are made for slope, frozen ground, and canopy (H-6). Given model complexity, data requirements, and minor improvement, RCN's appear to be a more usable choice for UFP.

<u>Hydrologic Condition Assessment and Proper Functioning Condition</u>

Although not mentioned by name in the policy, the context of ''building on existing systems'' implies extended use for both HCA (Hydrologic Condition Assessment) and PFC (Proper Functioning Condition). For HCA, the cost and risk involved in watershed development determines the nature of the hydrologic analysis, the objective of which should be to minimize risk by conservative design and good construction. Both high-cost and high-risk projects require detailed and localized geologic and hydrologic studies to avoid unnecessary risk, but even the more typical hydrologic analysis still has to focus on watershed processes, characteristics, precipitation, and runoff patterns throughout the basin. While this is essentially the point of view developed by HCA, the procedural disconnect between Step 3 and Steps 4, 5, and 6, leaves a practitioner without a path through to a usable outcome. These outcomes need to be specified as a part of the UFP policy - that is, after collecting a ton of data what do you want it used for and what do you want the final product to look like. I think that UFP needs to take on the chore of defining explicitly what end points are to be addressed.

Some Background for Hydrologic Condition End Points

1) Hydrologic functions are defined in several parts of CWA, SDWA, and NFMA; in particular, CWA S404 regs (40 CFR 230) and FSM 2510 as well as Regional handbooks such as R-2's Watershed Conservation Practices Handbook (FSH 2509.25). The most demanding task is watershed cumulative effects caused by changes in the hydrologic regime. At the basin scale, this is well scoped by Luna's book "A View of the River." At the project scale this is scoped by S404 regulations at 40 CFR 230.

2) All of these CWA USC references are to hydrologic condition/function at different scales. Impacts to be discussed in reference to:
   * Key species, natural temperature and flow patterns...33 USC 1314
   * Concentration and dispersal of pollutants (w/ by products) through biological, physical, and chemical processes and any related changes in the diversity, productivity, or stability...33 USC 1314
   * Description of factors related to rates of eutrophication; organic material accumulation; and inorganic sediment accumulation...33 USC 1314
   * Dissolved oxygen conditions needed by location, species, and activity (hiding cover, propagation, food supply, reproduction)...33 USC 1311
   * Effects of Road construction, use, and maintenance on the biological character or flow, reach, and circulation...[33 USC 1344
   * Factors needed for restoration of the natural chemical, physical, and biological integrity... 33 USC 1314
   * Effects on hydrologic cycle and storm runoff... 33 USC 1314

* Accurate assessment and comparison of existing condition to water quality objectives to be met.... 33 USC 1314

3) Several books including Luna's *A view of the River* (1994) and *Water in Environmental Planning* (1978 with Tom Dunne) provide an exceptional basis for understanding hydrologic condition and function. In 1985, the FS made an administrative effort to eliminate nearly all FSH technical handbooks including those dealing with hydrologic analysis. USFS R-2, Hydrology, made the decision to replace the FSH series with the 1978 *Water in Environmental Planning.* Basic questions in watershed science including hydrology and geomorphology were to be resolved in the technical context of the book.

4) The FSM 2510 Chapter on Watershed Planning includes specific direction ''To identify and evaluate watershed condition or damage producing events that cause threat to life or property, site deterioration, water pollution, or unsatisfactory water yield, and plan appropriate corrective action on the contributing watershed.'' (FSM 2510.2)

5) The purpose of an EIS (and EA) is to avoid speculation of impacts by ensuring that available data are gathered and analyzed prior to project action; including the cumulative effects of past and future harvest activity leading to aquatic habitat degradation (843 F.2d @1195). Impacts to fisheries include sediment effects on fish food production, reproduction, lower fish populations, and adverse shade removal effects on trout (843 F.2d @1194; 753 F.2d @ 759). All of these assessments are field oriented and involve interpretation of site specific information set against a standard framework pertinent to cumulative effects and aquatic habitat degradation.

6) NFMA, 16 USC 1604(g)(3)(E)(iii), provides the ''balancing test'' that Courts would use if an issue was raised. Note that Congress used the terms ''water conditions'' and ''fish habitat'', not just ''water quality'' or ''fish.'' And the regulations at 36 CFR 219.27(e) clearly intend that water conditions include hydrogeomorphic and channel conditions.

However, the NFMA regulation does not define how bad it has to be before conditions and habitat are ''seriously and adversely'' affected. Since these activities, especially roads, are also subject to CWA S404, the ''significant degradation'' standards at 40 CFR 230.10(c) become the primary test.

NFMA also establishes criteria for:
- watersheds, flood plains, and wetlands (36 CFR 219.23(a,b,c,e,f));
- recreation features (36 CFR 219.21(a)(1) and (g) off road vehicles;
- fish and wildlife (36 CFR 219.19); and
- T & E species (36 CFR 219.19(a)(7).

7) NFMA 36 CFR 219.23 Water and soil resource (paraphrased) requires Forest Planning to provide (a) estimates of current water use, including instream flows; (b) identification of significant impoundments, transmission facilities, wells, and other developments; (c) estimates of the probable occurrence of various water volumes; (d) compliance with the Clean Water Act, Safe Drinking Water Act, state & local requirements; (e) evaluation of current and future watershed conditions that influence water yield, soil productivity, water pollution, or hazardous events; and (f) adoption of measures to minimize risk of flood loss, to restore and preserve flood plain values, and to protect wetlands.

8) NFMA 36 CFR 219.23(d) directs USFS planning to comply with CWA including the State requests for information under S303, 305 and S319. Since water quality is an issue driven by the state, planners must use the CWA focus on basin (watershed and stream segment) planning as the authority for the size and description of accounting units. Visits with state personnel suggest that the use of FSM 2513 and 2541 watersheds is satisfactory.

FSM 2513.2 defines watershed size. Safe Drinking Water Act defines public water supplies (42 USC 300f) and critical protection areas for well heads (42 USC 300h 7) and special protection watersheds. FSM 2542 Regional supplements identify municipal watersheds.

9) NFMA at 36 CFR 219.23(d) requires forest plans to comply with CWA, including the need to abide by state requirements including S 319 report procedures. CWA grants the states substantial legal authority:

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1) To determine ''impairment'' by streams or watersheds.
2) To determine what activities are causing the problem.
3) To define ''maximum extent practicable'' for pollution control;
4) To determine applicable pollution control programs.
5) To apply programs watershed by watershed.
6) To establish and run pollution control programs.
7) To determine BMP's and measures that will be used.
8) To determine earliest practicable date for BMP implementation.
9) To prepare annual work schedules.
10) To ask for federal grants to do the job.
11) To generate annual watershed accomplishment reports.

10) Gosselink JG and LC Lee. 1987. Cumulative impact assessment in bottomland hardwood forests. Center for Wetland Resources, Louisiana State University, Baton Rouge,LA. (LSU-CEI-86-09). 55 pgs.). They develop a perspective based on whole watersheds and island biogeography. They recommend an assessment scale of 1 million ha (i.e. USGS Accounting Units; one up from cataloging unit; 1:250000 common USGS). Eight indicators of system integrity: 3 structural and 5 watershed response:

Structural (forest) compared to pre-settlement values because current natural conditions are relics. They have selected the following indexes for integrity based, in part, on the ability to get or estimate values from existing sources. That is, analysis has be possible within the constraints of data and people.

1) Forest loss: forest loss (as % of historical or potential)
2) Forest pattern: (patch size frequency distribution).
3) Forest contiguity: (stream interface/(potential interface)
   " " (upland forest interface/potential interface)
4) Change in discharge rating curves:
5) Change in water residence time:
6) Nutrient concentration
7) Nutrient loading
8) Biotic diversity

11) In 1985, the Chief made an agreement with EPA that raised WRENSS (Water Resource Evaluation of Nonpoint Silvicultural Sources) into official status as a handbook. WRENSS is about 800 pages and supports a wide range of hydrologic analysis. HCA mentions WRENSS as a standard handbook; however, there is no such reference in PFC.

My Perspective/Conclusion for UFP and related issues in HCA & PFC 41

1) The *A Framework for Analyzing the Hydrologic Condition or Watersheds* (HCA) provides a national framework for hydrologic analysis as a component of more comprehensive interdisciplinary watershed analysis. The HCA purpose is assess hydrologic changes in quantity, quality, or timing of streamflow re- sulting from land management actions.

   None of the legal framework has been addressed.

   HCA guidance outlines a process for identifying *essential* factors needed to describe hydrologic conditions from a vast array of possible factors. Such information allows members to participate effectively in addressing ecosystem and resource management planning issues. The USGS Techniques for Water Re- source Investigations and *An Approach to Water Resources Evaluation ...(WRENSS)* are given as examples of *standard* procedures.

   The HCA is intended to be watershed-specific. Under Step 3, the analyst is to consider factors that directly link to, and greatly influence, flow, qua- lity, or timing; are influenced by management; are obtainable (quantifiable and/or qualifiable); reflect the dominant biophysical processes; and have a definable reference or range of variation over time.

   HCA Step 6 for interpretation compares the existing to reference conditions based on an evaluation of the magnitude, direction, rate of change, and re- covery between current and reference values (i.e. Significant, moderate, or slight/no difference; High, moderate, slight/no recovery potential).

   Reference *(HCA Glossary p35) - The range of a factor that is representa- tive of its recent historical values prior to significant alteration of its environment. The reference could represent conditions found in a relic site having little significant disturbances, but does not necessarily represent conditions that are attainable. The purpose of references are to establish a basis for comparison what currently ex- ists to what existed in recent history. References can be obtained through actual data, such as paired watersheds, well-managed waters- heds, or extrapolated techniques such as modeling. Sources of in- formation include inventory and records, GLO and territorial surveys, settlers' and explorers' journals, ethnographic records, local knowledge, and newspapers.*

   The HCA interpretations key off the term "significant;" however, there is no definition in HCA of what that means nor does it discuss the context (other than *relic* and *environment*) in which it can be defined. Another confusion is that significance is also used in HCA with a statistical meaning which might not, and often does not, have practical application.

   If there is a real difference between two populations, then sufficient samp- ling will virtually guarantee statistical significance. However, the interest is with the practical differences important to ecological science, project administration, and stream health; not just statistical significance. HCA does not define a practical difference.

   What is worth detecting is a matter of judgement and policy as well as rela- tionships among variables and expected impacts. Since CWA S404 creates the most demanding hydrologic evaluations and the legal obligation to "fully con- sider" the views of the USF&WS (and NMFS if involved), the linkage to ecological integrity as viewed by these agencies needs to be explicitly defined. The USF&WS Habitat Evaluation Procedures (HEP) and Habitat Suitabi- lity Index (HSI) models can be used as a foundation. However, HCA carries no such direct linkage to HEP or HSI and the procedural disconnect between STEP 3 and STEPS 4, 5, and 6 compounds the problem.

2) USFS has adopted the BLM method for assessing proper hydrologic function (PFC) in wetlands and riparian systems. The difficulty, however, is that neither the FS nor the BLM have any authority under the Clean Water Act to cast up new definitions of hydrologic functioning. At least in the Courtroom sense, then, FS and BLM would be subject to the official guidance issued by EPA, the States, COE, USF&WS, and NMFS. Courts have tended to look at such official guidance as benchmarks from which you may do better, or the same in a different way, but not less than. While it may be years before PFC becomes

a legal issue, the review needed now is whether PFC, as currently constructed and taught, actually satisfies the various legal aspects. If not, then UFP can re-visit the application and strengthen it.

By way of example, compare the next two paragraphs that contain definitions provided by BLM and the S404 evaluation regarding wetland function. I think more resource protection can be accomplished by working within established frameworks instead of a PFC roll-your-own. The first paragraph is for PFC:

Proper functioning condition (PFC) - Riparian/wetland areas function properly when adequate vegetation, landform, or large woody debris is present to dissipate erosion energy associated with high waterflow and high wind wave action, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid flood plain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize shore and streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity.

The second paragraph comes from S404 (40 CFR 230) as it relates to all wetland functions including those of straight hydrology:
- natural biological functions: food chain production, habitat and nesting, spawning, rearing and resting sites for aquatic or land species;
- hydrologic functions: influence on natural drainage character istics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environ mental characteristics;
- buffer and shield functions: major protection of areas from wave action, erosion, or storm damage. Such wet lands are often associated with barrier beaches, islands, reefs and bars;
- flood control functions: storage areas for storm and flood wa ters;
- baseflow maintenance functions: natural recharge areas and ground water springs or seeps for low flows needed by aquatic resources;
- water purification functions;
- areas that are naturally unique or scarce in the re gion or local area; study areas or sanc tuaries or refuges.

CWA S404 Cumulative effects is driven by the fact that even minor changes in wetland functions may trigger major impairment in interrelated wetland systems. The evaluation is of the whole wetland system, not just the project site. The foundation of stream health has to include proper functioning condition; and if physical integrity is not maintained then robust stream health is not possible. But proper hydrologic function is insufficient by itself to conclude that robust stream health is also present. Stream health by stream miles is still the bottom line.

3) Watershed cumulative effects from massive changes made by human manipulation of water resources (illuminated by Leopold's *A View of the River)* have not been offered by HCA. And HCA does not address the scale-of-impact question. There is some help from the regulatory side (mainly S404b1 guidance). HCA does not now, but could, provide the operational definitions.

S404 requires a structured analysis that includes the nature and degree of effect on water, cur rent patterns, circulation including downstream flows, and normal water fluctuation; and on water chemistry, salinity, clarity, color, odor, taste, dissolved gas levels, temperature, nutrients, and eutrophication (40 CFR 230.23 &.24). Prolonged periods of inundation, exag gerated extremes of high and low water, or a static, nonfluctuating water level may change salinity patterns, erosion or sedimentation rates, aggravate water temperature extremes, and upset the nutrient and dissolved oxygen balance of the aquatic eco system. Expected loss of values includes obstructing or blocking flows or sediment transport; changing flow direction, velocity, volumes; changing periodicity of water movement, flooding, or sediment transport; or other wise changing the dimensions in location, struc ture, and dynamics of aquatic commu nities; shore, bank, and substrate erosion and deposition rates; the deposition, distribution, and mixing of dissolved and sus pended components; and water stratification. Neither HCA or PFC makes use of S404 - even though S404 is at the root of practically everything the land management agencies do.

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Bio logical and physical components of an aquatic system are either attuned to or characterized by periodic water fluctuations. Hydrologic modifications can alter or destroy communities and populations of aquatic animals and vegetation, induce populations of nui sance organisms, modify habitat, re duce food supplies, restrict movement of aquatic fauna, destroy spawning areas, and change adjacent, upstream, and downstream areas. These evaluations are part of S404 but not part of either HCA or PFC.

4) The U.S. Fish and Wildlife Service (USF&WS) is formally charged by law (16 USC 661 et seq) with providing detailed guidance regarding pollution effects on fish and wildlife resources. As part of that mandate, the USF&WS has developed and maintained a comprehensive set of Habitat Evaluation Procedures (HEP). There is no tie among HEP, PFC, or HCA.

5) The most detailed criteria for the evaluation of biological resource impact from pollution are those associated with CERCLA (43 CFR 11). CERCLA does not restrict biological assessments to any particular method; essentially any competent effort, done according to regulations for Natural Resources Damage Assessments (40 CFR 11 or 40 CFR 300) would be satisfactory. CERCLA regulations also say that assessment procedures are not mandatory; however, they must be used by Federal or State natural resource trustees to obtain the rebuttable presumption offered by CERCLA S 107(f)(2)(C) (43 CFR 11.10). A rebuttable presumption means the Court assumes you are correct until proven wrong.

One advantage to the use of HEP is that it is already listed as acceptable under CERCLA (43 CFR 11.71(1)) and would therefore allow the trustee to obtain the rebuttable presumption. To the extent that oil is involved, the Oil Pollution Act of 1990 (OPA) regulations supersede CERCLA; however, the rebuttable presumption and the use of HEP are maintained.

While CERCLA and OPA are perhaps uncommon in the sense of FS/BLM applications, why not build methods that are at least satisfactory for such application? The reason for looking at the most demanding requirements is so your horsepower is applied to the tough problems as well as the light duty. Why wouldn't ''good science'' incorporate the toughest standards?

6) S404 can present some very tough standards and prohibitions that should be part of any watershed assessment: S404 policy is to discourage unnecessary wetland alteration or destruction as contrary to the public interest. Generally S404 permits will NOT be granted if it involves the loss of important wetland functions or result in major impairment of interrelated wetlands UNLESS the Public Interest Review shows that the benefits outweigh the damage to the wet lands resource. If wetlands are impacted, a statement of finding required by EO 11990 that there are no practicable alternatives (supported by detail). Issues not addressed by either HCA or PFC.

7) The most desirable outcome is a unification of the concepts embodied in stream health, BLM's proper functioning condition (BLM 1993 & 94), riparian condition (as acceptable or unacceptable), and S404 criteria (40 CFR 230) that incorporates Fish and Wildlife Service expertise (and presumably the Habitat Evaluation Procedures and Habitat Suitability Index models). Some existing classifications that concern watershed processes or fluvial integrity are more or less official; for example:

Scale	T-Walk (prod)	R-2Range (SI -BC)	EPA BioCrit (%Ref&RBP)	BLM/FS (PFC)*	FS/WS I-III*	USF&WS HSI**
1.00						
0.90	__Rob		__Comparabl			<--Rob
0.85					(RA)	
0.80	..ade				__I	__Ade
0.75		__Accept	__Supportng	__PFC		
0.70	__Dim	Unaccp			(D)	
0.60			__PartlSupp	__AtRisk	__II	__Dim
0.55			Non-Suppr	NonFunc	III bad	
0.50	__Imp					
0.40					(IPC)	__Imp
0.30	__Pre					
0.20	Cat					
<0.2						__Pre Cat

* Numeric scales and the match-up to other classifications are inferred;

the methods themselves carry no narrative classes.
** HSI categories are explored in depth later because of the need to interpret chemistry against a fabric of habitat suitability.
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T-Walk is identified as a minimum standard for R-2 as part of the Watershed Conservation Practices Handbook FSH 2509.25 R-2 Supp. T-Walk uses these for a productivity scale; they are somewhat similar to the Integrated Biotic Index suggested by Karr and referenced by EPA (1983). R-2 Range Analysis pg 3-18 uses similarity index (based on Bray-Curtis index (1957) which was based on Dice Index (1945). Czaplewski's (1994) paper on ecosystem classification cites Landis and Koch (1977) for human health; Fleiss (1981) for "most purposes;" and Monserud and Leemans (1992) for global vegetation. Comparability was 0.8, 0.75, and 0.85 respectively.

EPA national biological criteria provide relationships for habitat support using a "Habitat Quality (% of Reference)" versus "Biologic Condition (% of Reference)." These are used in EPA's Rapid Bioassessment Protocol (1989RBP).

"An ecological basis for ecosystem management," chartered by Regional Forester Larry Henson and Rocky Mountain Station Director Denver Burns, provides some guiding principles but does not include any kind of a decision framework save that of natural functions and processes at some large scale and a focus on watersheds (Kaufmann et al 1994 p6). However, it is apparent that Kaufmann's analysis and assessment framework would fit within EPA's structure (Comparable ... Non-support) and the nomenclature could be applied directly to the coarse filter (p6) and at least provide a foundation for the fine filter.

For S404 evaluations, the nomenclature would also work; however, the fine filter could also be addressed by existing procedures and nomenclature if that was necessary for other resource or political reasons.

EPA 1995 re-issues guidance for S305b reporting that merges "comparable" and "supporting" into the single category "support." This now conflicts with both the Rapid Bioassessment Protocol (EPA 1989) and Natl Biological Criteria (1990). The 305 shift in definitions is a nuisance because the legislative history and 33 USC 1314 "key species, natural temperature and flow patterns" continues the need for a "comparable to natural" category.

8) Test procedures must be defined up front and used to classify activities and on-site conditions based on water quality risk: safeguarded, at-risk, and failure. These are part of hydrologic condition assessment and PFC is a part of that. Those used in T-Walk have been offered previously:

HYDROLOGIC AND WATER QUALITY TEST PROCEDURES

*	Test Procedures		Safeguard	At-Risk	Failure
1)	RCN hydrologic condition	(*1)	good	fair	poor & CDA
2)	Runoff/sediment control	(*2)	10yr24hr	<10yr24hr	CDA
3)	NPDES & SWPPP (toxics)	(*3)	25yr24hr	<25yr24hr	CDA
4)	Flood stability/80% life	(*4)	design	<design	<10yr
5)	Hydrologic function	(*5)	PFC	FAR	NonF
6)	Flow modification BMPs	(*6)	applied	not-app'd	SigDeg
7)	Emergency response/plan	(*7)	in-force	inactive	no plan

*1) RCN based on natural potential of good hydrologic condition. (Natural conditions with lower potential, such as arid grasslands, set their own reference for potential.
*2) Runoff/sediment control complies with SWPPP and S404 BMPs. Safeguard handles design storm without damage; at-risk does not. CDA= failure.
*3) Permits comply with conditions. Safeguard handles 25yr design storm without damage; at-risk does not. CDA and/or no permit = failure.
*4) Structures comply w/ S404 & Watershed Conservation Practices criteria for an 80% chance of not being destroyed during its design life.
*5) Hydrologic function based on flood access to floodplains, water table maintenance, and sediment transport. PFC= Proper Functioning Condition, FAR= Functioning-at-Risk, NonF= Non-functioning
*6) Flow modification BMPs (from COE & S319 process). Significant Degradation is tested with S404 guidelines (40 CFR 23).
*7) USFS Emergency response/plan or EPA Spill Contingency guidance.

End of comment re watershed assessment and hydrologic condition.