

Level 1	Level 2	Vital Sign	Measurement (examples)
Air and Climate	Air Quality	Air Chemistry - ozone	Atmospheric ozone concentration, foliar ozone damage
		Air Chemistry - nitrogen/sulfur deposition	Wet deposition chemistry (pH, NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>=</sup> ), continuous sulfur (SO <sub>2</sub> ) dioxide concentrations
		Air Chemistry - fine particles	Atmospheric particulate concentrations (SO <sub>4</sub> , NO <sub>3</sub> ), elemental and organic carbon, NH <sub>4</sub>
		Air Chemistry - contaminants	Volatile organic chemical concentrations (benzene, toluene, ethylene chloride), dioxin concentrations, atmospheric metal concentrations (Hg, Pb, Cd, Co, Zn, Ni)
	Weather	Visibility Weather/Climate change	IMPROVE monitoring Precipitation (snow, rain, fog, etc.), temperature, wind speed and direction, solar radiation, relative humidity
Geology	Geomorphology	Hillslope features and processes	Surface displacement; location, area, rate, frequency, and magnitude of movement; feature characteristics
		Stream / river channel characteristics	Channel width, depth, and gradient; sinuosity; channel cross-section; pool frequency and depth; suspended sediment and bedload transport, particle size distribution, incision
		Lake features	Sediment size distribution and chemistry, macrofossils and pollen content, shoreline erosion rates
	Subsurface Geologic Processes	Caves / Karst / Mineshaft features and processes	Temperature, humidity, gas concentration, water chemistry and quality, temporal changes in cave deposits, biota (species and distribution)
	Disturbed Lands Other	Abandoned Mine Lands Paleontology	Mine drainage, contamination (pH, lead, zinc, mercury etc.) Erosion rates

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<b>Soil</b>	Soil quality	Soil erosion	Changes in thickness of topsoil, rill and gully density/dimensions, pedestals, terracettes
		Soil aggregate stability	Aggregate stability test (Soil Quality Test Kit)
		Soil biota	Species composition and distribution with soil depth, soil respiration (mg CO <sub>2</sub> -C/m <sup>2</sup> /hr)
		Bare soil surface	Basal gap intercept, percent cover
		Soil organic matter	Basic soil analysis of surface and near surface soil horizons, C:N ratio
		Soil chemistry - contaminants	Presence of volatile organic chemical concentrations (benzene, toluene, ethylene chloride, etc.), dioxin concentrations, atmospheric or surficial deposition of metal concentrations (Hg, Pb, Cd, Co, Zn, Ni, etc.)
		Soil chemistry - nitrogen/sulphur	Changes in soil pH, soil buffering capacity, nutrient cycling rates (may be a soil or ecosystem process depending on scale and inference)
		Soil compaction	Bulk density (g/cm <sup>3</sup> ), infiltration rate, penetration test
		Soil hydrophobicity	Water repellency test at various soil depths
<b>Water</b>	Hydrology	Groundwater dynamics	Depth to groundwater, well recharge rate
		Water Quantity	discharge (cfs or cumes) gauge/stage height, lake elevation, qualitative estimate of flow relative to bank full (stream) or level (lake)
	Water Quality	Water Chemistry	4 core (pH, DO, conductance, temp), cations (Ca, Mg, Na, K), anions (PO <sub>4</sub> , NO <sub>2</sub> , Br, SO <sub>4</sub> , Cl, acid neutralizing capacity), turbidity, suspended sediments, BOD, COD, alkalinity, Secchi disc
		Water Quality - nutrients	N & P compounds, chlorophyll a
		Water Quality - toxics	VOCs, SVOCs, pesticides, PCBs, metals, etc. Other organic and inorganic substances.
Water Quality - microorganisms	viruses/enteric, fecal coliform bacteria (total coliform, enterococci, fecal streptococci groups, E. coli).		
Water Quality - macroinvertebrates and algae	species composition and abundance		

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Biological Integrity	Invasive Species	Occurrence of invasive plants & animals	Distribution of japanese barberry; % non-native fish in sample, etc.
		Insect infestations	Woolly adelgid, gypsy moth, emerald ash borer, etc.
	Focal species or communities	Aquatic Vegetation	Woolly adelgid, gypsy moth, emerald ash borer, etc. distribution
		Grassland/Shrubland Community	Community species composition
		Riparian communities	Area and species composition
		Riverscour/Flatrock Community	Community species composition
		Bioaccumulation of toxins / contaminants	Tissue Hg in American Eels, Otters
		Animal disease and pathogens	West Nile Virus, Brucellosis, CWD, internal parasites, TB, etc.
		Plant disease and pathogens	Root rot (Armillaria), blister rust+D90, Dogwood Anthracnose, etc
		Freshwater mussel communities	Spp composition and abundance
		Invertebrate biodiversity	Species richness
		Stream/river fish communities	Spp composition and age structure
	At-risk biota	Amphibians	species richness, abundance
		Reptiles	species richness, abundance
		Forest bird communities	Forest neotropical migrant diversity
		Beavers	Presence and distribution of beaver dams and ponds
		Bat Communities	Species composition, diversity and abundance
		Small Mammals, fish, nesting birds, etc	Community richness, etc
		Salamanders	species richness, abundance
		Human-wildlife conflicts	Black bear, White-tailed Deer, Otter
Overabundant wildlife		White-tailed deer	
Significant populations		Abundance of Cerulean Warblers, Swainson's Warblers, Bats, Riverscour plants, etc.	
Predominant plant communities	State T&E species	Density of species X	
	Federal T&E species	Virginia Spirea, Dwarf Wedgemussel, Bog Turtle, population size, etc.	
	Forest community structure and demography	Ponderosa pine (oak, etc.) stand size structure	
	Wetlands	Spp composition, production, structure, etc.	
	Riparian communities	community structure, distribution	

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<b>Human use</b>	Point source human effects	Chemical contamination	Acres/stream miles contaminated by mine drainage	
		Fire control	Acres thinned; miles of maintained fire roads; acres of prescribed burn	
		Sewage contamination	Gallons of raw sewage emitted; stream miles contaminated	
	Non-point source human effects	Dark night skies	Number of visible stars	
		Consumptive use	Wildlife harvest	Deer, Bear, etc.
	Visitor and recreation use	Firewood harvest	Firewood harvest	Quantity (m3, cords, acres cut) of firewood removed
			Fish harvest	Eel/Shad counts in Delaware river, etc.
		Natural sound levels	Natural sound levels	Sound levels in remote areas, sound from overflights
			Natural sound levels	Sound measurements of overflights
			Dark night sky	Visitor response to surveys, satellite images of park region
<b>Ecosystem pattern and processes</b>	Fire	Fire dynamics	Size, intensity, return interval	
		Fuel dynamics	Fuel load and distribution	
	Land use	Land use	Road density, housing density, recreational use intensity, etc.	
		Land cover	Area of dominant land cover types	
	Nutrient dynamics	Landscape Pattern	Landscape Pattern	Patch size distribution, distance between patches
			Nutrient turnover	C, N, P dynamics in aquatic or terrestrial systems
		Productivity	Biomass production	biomass production in aquatic or terrestrial systems. NDVI-derived vegetation growth index, etc.