We are asking support from scientists for the development of sustainable groundwater management principles and practices on National Forests and Grasslands. NRDC recently highlighted the importance of high quality, abundant groundwater from National Forests and the threats it faces. Proper groundwater management on our National Forests would help maintain a clean source of drinking water and a sustainable supply of water to keep forests healthy, wetlands wet, and streams flowing.

The proposed US Forest Service Groundwater Directive is the first comprehensive set of guidance from the Forest Service on groundwater resources and could be one of the first national policies to protect groundwater quality and quantity for ecosystems. The Directive outlines the Forest Service's definition of sustainable use, making the assumption that surface and groundwater systems are interconnected. It establishes high level criteria to ensure that any entity proposing to access groundwater will need to develop monitoring and mitigation strategies to protect surface and groundwater from degradation of quantity or quality.

We have reviewed the Directive and believe it to be a good first step, but are concerned that the Forest Service does not adequately address the need for scientifically supported comprehensive groundwater management which includes baseline assessments, sustainable groundwater standards, and a comprehensive monitoring and mitigation program. We also see a need for stronger protection groundwater dependent ecosystems and aquifers from adverse impacts of mineral extraction and energy development.

In coordination with 55 other conservation groups we submitted technical comments on the Directive to the Forest Service. We've also drafted a shorter letter (below) focused on scientific elements that we believe would support more effective sustainable management of groundwater resources and the ecosystems that depend on them. We see your support from experts in the field as invaluable. If you are interested in signing on to this letter, please send a confirmation of your interest to Jake Sahl (jsahl@nrdc.org) by COB October 2, 2014.

Best,

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October 3, 2014

The Honorable Thomas Vilsack
Secretary, U.S. Department of Agriculture
1400 Independence Avenue SW Washington, DC 20250

The Honorable Thomas Tidwell
Chief, U.S. Forest Service
Yates Building, 5th Floor, NW Wing
201 14th St, SW
Washington, DC 20250

Also sent as official comments via email to: fsm2500@fs.fed.us

RE: U.S. Forest Service Proposed Groundwater Directive

Dear Secretary Vilsack and Chief Tidwell,

We, the undersigned scientists, support sustainable groundwater management and the protection of groundwater dependent ecosystems on National Forests and Grasslands, as well on other lands. For sustainable management of our natural resources and water supplies, it is critical to protect groundwater resources from excessive withdrawals and contamination, to keep sufficient water in streams and wetlands, and to provide reliable water supplies to local and downstream water users. We support the U.S. Forest Service's important efforts to develop comprehensive, science-based monitoring and management of these resources with their proposed Groundwater Directive (Directive). The proposed Directive is an excellent first step, but it could be improved in several elements. With this letter, we write to offer some comments and suggestions for how the Directive could be improved and to urge the Forest Service to finalize and adopt the Groundwater Directive.

Outside of glaciers and ice caps, groundwater is our largest bank of fresh water on the planet, yet we currently lack an adequate accounting system for this resource.[1] Services provided by groundwater include water storage, contribution to streamflows, natural water purification, and erosion regulation and flood control.[2] However, insufficient groundwater monitoring and management has led to severe groundwater level declines in many parts of the U.S. For instance, from 1900 – 2008, approximately 810 million acre feet of groundwater volume has been depleted in the United States.[3] U.S. Geological Survey studies have also demonstrated the impacts of declining groundwater levels on land subsidence, water quality, water supply costs, and streamflows.[4] A wide range of surface-disturbing activities on and near national forests and grasslands pose risks to groundwater quality as well. If groundwater is contaminated, it can negatively impact drinking water sources and the health of groundwater dependent ecosystems. Without a comprehensive and sustainable groundwater management framework in place, these impacts will not be detected until it is too late.

One of the most promising aspects of the proposed Directive is the assertion that our rivers and lakes are physically connected to the waters underground. Shallow aquifers maintain direct hydraulic connection to surface ecosystems, which is crucial to sustaining river flows, springs, and wetland viability.[5,6] For small and medium sized streams, particularly prominent on National Forest lands, estimates are that between 40% and 50% of stream baseflow is from groundwater discharge.[7] Groundwater input to rivers and streams is also an important determinant of spawning habitat for trout and other salmonids and regulates temperature and baseflow during the summer.[8] However, groundwater pumping can intercept flow that would normally end up in surface waters, increase the rate of loss from surface waters, and lower groundwater levels below the depth that streamside or wetland vegetation needs to survive.[9]

The Forest Service has the opportunity to develop a sustainable groundwater management[10] framework, but will first need to develop a comprehensive plan and implementation strategy that encompasses protection, outcomes-based monitoring, and mitigation. In particular, monitoring can provide critical baseline data to assess changes due to human activities and seasonal variation. Developing a scientifically robust, comprehensive monitoring program that addresses long term impacts, including climate change and drought preparedness is a necessary step. Initial implementation of the Directive should include baseline groundwater monitoring programs on National Forests to assess aquifer characteristics, groundwater dependent ecosystems, and groundwater quality and to develop an understanding of available resources and potential threats. Monitoring of impacted systems should recognize the lag time between groundwater use and

[1] Brown, J., A. Wyers, A. Aldous, and L. Bach. 2007. Groundwater and biodiversity conservation: A methods guide for integrating groundwater needs of ecosystems and species into conservation and plans in the Pacific Northwest. 176 pp.

[2] Groundwater dependent ecosystems include 1) terrestrial vegetation and fauna that have seasonal dependence on groundwater (e.g. riparian areas); 2) ecosystems dependent on rivers and streams that are eventually fed by groundwater; 3) aquifer and cave ecosystems; 4) wetlands and lakes that are mainly fed by groundwater; 5) estuarine and coastal lagoons that depend on the discharge of groundwater floods. Groundwater dependent ecosystems also specifically include fens, seeps, and swamps. See Foster S., P. Koundouri, A. Tuinhof, K. Kemper, M. Nanni and H. Garduño. 2006. Groundwater-dependent ecosystems: The challenge of balanced assessment and adequate conservation. Sustainable Groundwater Management, Concepts and Tools. Briefing Note Series, Note 15. The World Bank.

[3] Konikow, L.F., 2013, Groundwater depletion in the United States (1900−2008): U.S. Geological Survey Scientific Investigations Report 2013−5079, 63 p., http://pubs.usgs.gov/sir/2013/5079.

[4] Konikow, L.F., 2013, Groundwater depletion in the United States (1900−2008): U.S. Geological Survey Scientific Investigations Report 2013−5079, 63 p., http://pubs.usgs.gov/sir/2013/5079.

[5] Morris, B.L., Lawrence, A.R.L., Chilton, P.J.C., Adams, B., Calow, R.C., and Klinck, B.A. 2003. Groundwater and its Susceptibility to Degradation: A Global Assessment of the Problem of Options for Management. Early Warning and Assessment Report series, RS. 03-3. United Nations Environment Programme, Nairobi, Kenya; Shaw, E.M. 1994. Hydrology in Practice. Chapman and Hall, London.

[6] Falkenmark, M. and J. Rockström. 2004. Balancing Water for Humans and Nature. London: Earthscan

[7] Alley, W.M., T.E. Reilly, and O.L. Frank. 1999. Sustainability of groundwater resources. USGS Circular 1186.

[8] e.g. Baxter, J. and J. McPhail. 1999. The influence of redd site selection, groundwater upwelling, and over-winter incubation temperature on survival of bull trout (Salvelinus confluentus) from egg to alevin. Canadian Journal of Zoology, 77(8): 1233-1239.

[9] Konikow, L.F., 2013, Groundwater depletion in the United States (1900−2008): U.S. Geological Survey Scientific Investigations Report 2013−5079, 63 p., http://pubs.usgs.gov/sir/2013/5079.

[10] We recommend the Forest Service adopt the following definition for *sustainable use*, as recently summarized by the California Water Foundation: *The rate of groundwater use that provides for multiple long-term benefits without resulting in or aggravating conditions that cause significant economic, social, or environmental impacts such as long-term overdraft, land subsidence, ecosystem degradation, depletions from surface water bodies, or water quality degradation, and that protects the resource for present and future generations.* California Water Foundation. 2014. Recommendations for Sustainable Groundwater Management: Developed Through a Stakeholder Dialogue. 43 pp.

surface water depletions, which may range from months to years and should continue until any adverse impacts have been fully and permanently mitigated.

In the proposed Directive, the Forest Service applies lesser protections to groundwater when mineral and energy development is involved than for other surface-disturbing activities. The proposed Directive should be revised[11] to require mineral and energy development to meet the same monitoring and mitigation standards as other uses and those outlined above. Numerous examples demonstrate the need for such an approach. Oil and gas exploration and production in the United States has left behind a legacy of pollution and environmental impacts, from both conventional and newer, unconventional development.[12] For example, a multi-year, interdisciplinary study of produced water releases at an oil production site in Oklahoma undertaken by the U.S. Geological Survey found that soil and groundwater at the site were still polluted after more than 60 years of natural attenuation.[13] Impacts of oil and gas production include degradation of soils and water caused by releases of hydrocarbons and co-produced brine, known as "produced water", which can contain toxic chemicals such as benzene and other volatile organic compounds, heavy metals, and radioactive materials.[14,15] Coal mining also poses a serious threat to groundwater resources through a number of avenues. In many cases coal seams are aquifers themselves, which are often dewatered to access the coal; this dewatering draws in water from nearby aquifers as far as three miles away, having a domino-like effect.[16] Contamination caused by these impacts can be technologically and financially difficult to remediate, if it is not impossible to do so.

The importance of informed, sustainable management of our groundwater resources is becoming increasingly apparent. We applaud the Forest Service's work to develop the proposed Groundwater Directive and are pleased to provide these comments to support finalization and adoption of the Directive. Thank you for consideration of our views.

Sincerely,

Supporters (in alphabetical order):
Note: Affiliations are for identification purposes only and do not constitute an endorsement on the part of the institutions of information contained in this letter.

[11] First, the Directive should be amended to remove the exemption for minerals and energy development in Section 2561.4. Additionally, the proposed Section 2561.4 appears to exempt mineral and energy development from appropriate monitoring and mitigation measures. The Directive should require the assessment of geological and hydrogeological conditions in all areas proposed for mineral or energy development rather than shallow natural gas sites.

[12] Otton, J. K. 2006. Environmental aspects of produced-water salt releases in onshore and estuarine petroleum producing areas of the United States - a bibliography. U.S. Geological Survey Open-file report 2006-1154. Retrieved from http://pubs.usgs.gov/of/2006/1154/pdf/of06-1154_508.pdf

[13] Kharaka, Y. K., & Otton, J. K., eds. 2003. Environmental impacts of petroleum production - Initial results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. U.S. Geological Survey Water-Resources Investigations Report 03-4260.

[14] Kharaka, Y. K., & Dorsey, N. S. 2005. Environmental issues of petroleum exploration and production: Introduction. Environmental Geosciences , 12 (2), 61-63.

[15] Veil, J. A., Puder, M. G., Elcock, D., and Redweik Jr, R. J. 2004. A white paper describing produced water from production of crude oil, natural gas, and coal bed methane. Prepared by Argonne National Laboratory for the US Department of Energy, National Energy Technology Laboratory, January. Available at http://www. ead. anl. gov/pub/dsp_detail. cfm.; Alley, B., Beebe, A., Rodgers Jr, J., & Castle, J. W. 2011. Chemical and physical characterization of produced waters from conventional and unconventional fossil fuel resources. Chemosphere, 85(1), 74-82.; Zielinski, R. A., & Otton, J. K. 1999. Naturally Occurring Radioactive Materials (NORM) in Produced Water and Oil-field Equipment: An Issue for Energy Industry. US Department of the Interior, US Geological Survey.

[16] National Research Council. 1990. Surface Coal Mining Effects on Ground Water Recharge, Committee on Ground Water Recharge in Surface-Mined Areas, Water Science and Technology Board. 170 pp.