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United States
Environmental Protection
Agency
Office of Ground Water

Region 10
1200 Sixth Avenue
Seattle WA

August 1987

EPA

Resource Document

For Consideration of the North Florence Dunal Aquifer as a Sole Source Aquifer

RESOURCE DOCUMENT FOR CONSIDERATION OF THE NORTH FLORENCE DUNAL AQUIFER AS A SOLE SOURCE AQUIFER

Prepared by
the Office of Ground Water
U.S. EPA Region 10
Seattle, Washington 98101

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INTRODUCTION

Sole Source Aquifer Program

The Safe Drinking Water Act, Public Law 93--523, was signed into law on December 16, 1974.[1] This act provided the statutory basis for designation of sole source aquifers by the Environmental Protection Agency. Section 1424(e) of the Act states:

> "If the Administrator determines, on his own initiative or upon petition, that an area has an aquifer which is the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health, he shall publish notice of that determination in the Federal Register. After the publication of any such notice, no commitment for Federal financial assistance (through a grant, contract, loan guarantee, or otherwise) may be entered into for any project which the Administrator determines may contaminate such aquifer through a recharge zone so as to create a significant hazard to public health, but a commitment for Federal assistance may, if authorized under another provision of law, be entered into to plan or design the project to assure that it will not so contaminate the aquifer."

Petition

On June 2, 1985, the Region 10 Office of the Environmental Protection Agency (EPA) received a petition from Shirlee J. Gardinier, a citizen of Florence, Oregon, requesting that EPA designate the North Florence Dunal Aquifer as a sole source aquifer.[2] The petitioner provided EPA with additional technical information on July 30, 1985. A Federal Register notice announcing receipt of the petition and requesting public comment was published on November 13, 1985.[3] Another Federal Register notice, published on March 3, 1986, announced the publication of a support document and requested further public comments through August 1, 1986.[4] An additional public comment period is now open to provide an opportunity to review recently revised boundaries of the proposed sole source aquifer area.

Purpose

This document represents a summary of available information which will serve to provide the basis for an EPA decision regarding sole source aquifer designation. Those interested in more detailed information may consult the references listed at the end of the report.

GENERAL DESCRIPTION OF THE NORTH FLORENCE DUNAL AREA

Location

The North Florence Dunal Aquifer represents a hydrologically isolated portion of an extensive dunal aquifer system located along the south-central Oregon coastline. The entire dunal aquifer system, whose width ranges from less than one mile to over three miles, extends almost 60 miles from Coos Bay north to Heceta Head. The dunal area north of the Siuslaw River, herein referred to as the North Florence Dunal Aquifer, includes nearly 20 percent of the total dunal aquifer system area.

The area originally petitioned for sole source aquifer status included only the unconsolidated sand deposits between the Siuslaw River and Sutton Creek. However, available information suggests that the sand dune area north of Sutton Creek is not hydrologically separate from the rest of the aquifer. Also, part of the bedrock surface east of the dunes supplies runoff into lakes which are hydrologically connected to the aquifer. Therefore, it seems appropriate to include these areas into the proposed sole source aquifer area. A more thorough description of the boundaries associated with the aquifer occurs later in this report, as does a map (Attachment 1) which delineates those boundaries.

Climate

A temperate marine climate with distinct wet and dry seasons prevails in the area. Temperature records from Reedsport, located 20 miles south of Florence, show an average annual temperature of 52 degrees (Farenheit). The July-August temperature averages 61 degrees whereas the January temperature averages 45 degrees.[5] Rainfall at Florence averages 65 inches per year with about 80% occurring between the months of October and March.[5,6]

Population

Over 8,000 people reside in the North Florence Dunal Area, including about 4,500 within the city limits of Florence.[6,7] Since tourism forms the principal industry of the area, summertime population figures must be considerably higher. According to the Lane County planning staff, about 15,000 people will reside in the area by the year 2,000 and, ultimately, the population may approach 25,000.[5]

Geology

BEDROCK UNITS

The wind-blown sand of the dunal aquifer rests upon a wave-cut terrace of sedimentary and igneous bedrock. Sandstone and siltstone beds, whose grains are cemented by clay minerals and calcite, crop out along most of the eastern boundary of the aquifer.[6,8] These beds were exclusively correlated with the middle Eocene Tyee Formation until 1974. Since then, some investigators have grouped the strata with the Flournoy Formation while others hold to the original correlation.[9,10] The upper Eocene Yachats Basalt crops out along the northeastern margin of the aquifer for about one mile. This complex assemblage of volcaniclastic rocks and ancient lava flows erodes less easily than the sedimentary bedrock as evidenced by the rocky headland of Yachats Basalt north of the dunal aquifer.[8] Springs and wells in the bedrock units yield only very small amounts of water.[5]

UNCONSOLIDATED MATERIAL

Surface expressions of the sand cover have been categorized into three groups: active dunes, stabilized dunes, and deflation plains.[8] Active dunes are those areas with little or no vegetation covering them which move freely in response to the wind. Stabilized dunes, as the name implies, represent those areas covered by enough vegetation to hold the sand in place. Recently stabilized dunes contain a cover of grasses and shrubs whereas forests cover dunes which were stabilized decades ago. Deflation plains are areas eroded by wind (deflated) down to the summer water table elevation. These marshy wind-scoured depressions generally expand during the winter and spring as the water table rises. Active dunes observed presently encroaching upon forested areas illustrate the dynamic nature of the sand-covered land surface. Surface cuts and boreholes, which show multiple buried soil horizons and peat beds, indicate a history of continual sand movement.

Numerous borehole records combined with a seismic survey by Oregon State University have allowed fairly detailed characterization of the aquifer portion between Sutton Creek and the Siuslaw River. Key findings from subsurface investigations include: (1) unconsolidated sand thicknesses average 100-200 feet; (2) since the sand lies upon a flat bedrock surface, topographic highs in the dunes correspond to thicker accumulations of wind-blown sand; (3) abrupt thinning occurs not only along the eastern and northern aquifer margin, as would be expected, but also around a buried sea stack located under the coastal highway northwest of Clear Lake; (4) the lower one-third of the sand is largely impermeable because of plastic clay between the sand grains.[6,11]

Desposition by wind has produced a sand body of quite uniform grain size and fairly uniform grain composition. According to sieve analysis of samples taken just north of Florence, 96-99 percent of the grains are of medium- and fine-grained sand size.[5] Mineralogical studies along the Oregon coast have shown that dune sands contain 70-99 percent quartz with the higher amounts of quartz generally found furthest from the ocean.[12] Chemically unstable rock fragments account for most of the balance.[13] The uniformly sand-sized particles, when saturated, can hold and transmit large quantities of water.

Hydrology

A favorable combination of geologic and climactic factors make the dunal aquifer an immense dynamic reservoir of ground water. Laboratory studies suggest that mobile ground water accounts for 32 to 35 percent of the aquifer volume.[5]. Measured permeabilities range from 270 to 600 gallons per day per square foot.[5] From a water development standpoint, the thick accumulation of porous and permeable sand will yield in excess of 150 gallons per minute to properly constructed wells.[5] Natural recharge and discharge in 1963, when the area was less urbanized, was estimated at 3000 acre feet per year for each square mile of the aquifer.[5] Although ground water withdrawals have increased significantly since then, natural discharge still greatly exceeds consumption.

Approximately 85 percent of the rain which falls upon the sand-covered surface percolates into the water table.[5] Locally, discontinuous buried soil layers and peat beds, both partly cemented by iron oxides, act to retard veritical movement.[5,6] However, on a large scale, ground water moves rapidly and almost uniformly towards a discharge point. In fact, tritium age dating indicates that water in the aquifer replaces itself at least every 30 years.[6]

The North Florence Dunal Aquifer discharges principally into the Pacific Ocean and Siuslaw River. Multiple seeps and springs occur along the coastline and riverbank, although areas of quicksand indicate that the aquifer discharges mostly as underflow.[5] The water table slopes westward at about 10 feet per 1,000 feet and southward at about 5 feet per 1,000 feet from its highest portion, located west of Mercer, Collard, and Clear Lakes.[11] Munsel Creek intercepts some of the ground water flowing towards the Siuslaw River. Likewise, Sutton Creek and Berry Creek intercept some of the westward moving ground water before it discharges into the Pacific.[5,6]

The string of lakes along the eastern boundary of the aquifer are a minor discharge area. However, the aquifer supplies a significant amount of water to the lakes, especially during the summer months when surface water inflow decreases and withdrawals from Clear Lake are increased. Hydrographs comparing lake levels with aquifer levels strongly suggest a hydrologic connection between the surface and ground water supplies.[5] More refined studies estimate that the aquifer supplies at least 27% of Clear Lake's annual water supply and a much higher proportion during the dry season.[14]

Few streams cross the dunal area since most rainfall quickly infiltrates to the water table. Those streams which do flow across the area (Munsel Creek, Sutton Creek, and Berry Creek) originate in upland areas of relatively impermeable bedrock. Where streams flow across the sand they are hydrologically connected with the ground water system. In fact, effluent ground water provides most of the flow of Sutton and Munsel Creeks at their points of discharge.[6]

Aquifer and Designated Area Boundaries

The North Florence Dunal Aquifer encompasses the entire continuous body of sand located north of the Siuslaw River and east of the Pacific Ocean. The surface contact between bedrock and the unconsolidated sand forms the northern and eastern boundary of the designated area as far south as Mercer Lake. The boundary between bedrock and the dunal aquifer has been drawn on the basis of a surface geological map published in 1974 by the Oregon Department of Geology and Mineral Industries.[8] In addition to the dunal sand area itself, steep drainage areas east of Collard, Clear, Ackerley, and Munsel Lakes have been included in the proposed designated area because those lakes are hydrologically connected to the aquifer.[5,6] Therefore, the surface drainage divide located just east of the lakes forms the eastern boundary of the area proposed for designation from Mercer Lake south to the Siuslaw River.

Ground Water Quality

From a human health standpoint, the aquifer provides water of good quality. However, naturally high concentrations of dissolved iron require treating the water for aesthetic reasons. The naturally high dissolved iron content apparently results from weakly acidic ground water (pH of 5.6 to 6.2) reacting with the iron-rich minerals found in some sand grains.[6]

Potential for Contamination

Rapid infiltration rates into the sand cover combined with a shallow water table make the North Florence Dunal Aquifer highly susceptible to contamination from surface activity. Despite the relatively rapid flow of ground water through the aquifer, water soluble contaminants introduced near the surface may remain in the ground water system for nearly 60 years.[6] Immiscible contaminants, such as petroleum distillates, would spread rapidly if spilled onto the permeable sand cover but would resist flushing by natural ground water flow.

Possible sources of aquifer contamination include fuel storage tank failure, accidental spills of hazardous material transported across the aquifer, septic tank effluent, storm runoff, pesticides, and chemical fertilizers. The lakes located along the eastern margin of the dunal area would suffer from any contaminants introduced into that portion of the aquifer which recharges the lakes. Direct leaching from septic tanks located in sand-covered areas adjacent to the lakes could seriously downgrade the quality of Clear Lake - the only surface source of drinking water presently used in the area.[14]

Localized overpumping of the aquifer near the ocean could result in saltwater intrusion. However, population projections by the Lane County Planning Staff suggest that such overdrafts are unlikely.

Water Supply Systems

Drinking water for the proposed sole source area comes almost exclusively from two water districts. The City of Florence serves areas within the city limits whereas the Heceta Water Distrist serves residents outside of Florence. Florence produces most of the water it consumes from two city owned and operated wells. A treatment plant near the wells precipitates and filters out the iron in addition to providing chlorination.[15] The city purchases supplemental water from the Heceta Water District during seasonal periods of increased demand. The Heceta Water District pumps water from Clear Lake and distributes it after chlorination. As of 1985, withdrawals from Clear Lake by the water district accounted for about 18% of annual outflow from the lake.[14] Although the Heceta Water District has only a few hundred connections fewer than Florence, a much higher percentage of its customers are seasonal residents. Accordingly, annual production by the Heceta Water District averages less than half that of the City of Florence.

Alternative Sources

Locally available surface water cannot qualify as a truly alternative source because of the hydrologic connection between surface water and ground water across the dunal surface. For instance, aquifer recharge to Clear Lake during the summer months, when surface inflow drops sharply and water consumption rises dramatically, already represents a major part of the lake's inflow. Therefore, additional pumping from Clear Lake would, in essence, simply represent additional pumping from the aquifer.

Coastal lakes south of the Siuslaw River, such as Woahink Lake, have been suggested as an alternative water source. However, transmission lines and chemical treatment of the poorer quality water would greatly increase consumer costs. Furthermore, the coastal lakes to the south, which are also hydrologically connected to a dunal aquifer, are as vulnerable to contamination as the lakes north of the Siuslaw River.

Streams which originate in the bedrock uplands east of the aquifer lack the year-around flow needed to meet water consumption in the area. Original studies of the dunal aquifer at Florence were conducted over 25 years ago because surface streams and wells drilled into bedrock could not meet the growing water needs of the area.[5] Any reservoir construction projects designed to provide a steady supply of surface water would face serious obstacles which include: (1) steep topography susceptible to landslides; (2) bedrock units which present engineering difficulties; and (3) silting problems associated with runoff from heavily logged slopes.[8] These obstacles alone would raise costs to prohibitive levels.

TABLE 1

ANNUAL WATER CONSUMPTION WITHIN THE PROPOSED SOLE SOURCE AQUIFER AREA

	Volume in Million Cubic ft.	Approximate Number of Connections	Approximate Population Served
1. Ground Water Use			
City of Florence	29.3[a]	1600[b]	4565[c]
Individual Wells	0.2[d]	30[e]	81[f]
Total Ground Water Use	29.5	1630	4646
2.*Surface Water Use			
Heceta Water District	11.5[g]	1237[h]	3750[i]
City of Florence	2.3[j]	Supplemental Use Only	
Total Surface Water Use	13.8	1237	3750
3. TOTAL (all sources)	43.3	2867	8396

4. Surface Water as a Percentage of Total Water Use in the Area: 32%

5. Ground Water as a Percentage of Total Water Use in the Area: 68%

* All surface water withdrawals are from Clear Lake. The North Florence Dunal Aquifer is hydrologically connected with Clear Lake and provides about 27% of its annual inflow.[14]

TABLE 1 NOTES

a) Source: The City of Florence estimates that its recently rehabilitated wells presently produce about 600,000 gallons per day, which is equivalent to 29.3 million cubic feet per year. Iron precipitation problems will probably cause production to drop and generate another workover treatment at some point in the future.

b) Source: Approximate number of connections according to the City of Florence.

c) Source: Oregon Blue Book, 1987-88, published by the Secretary of State.

d) Source: Annual consumption was estimated by assuming 30 connections each use 150 gallons per day throughout the year.

e) Source: Number of residences estimated by the Heceta Water District as within the proposed sole source aquifer area which are not served by a public water supply system.

f) Source: Estimated number of connections was multiplied by 2.7 to arrive at this figure.

g) Source: 1985-1986 water production which was used by Heceta Water District customers rather than sold to the city of Florence.

h) Source: Connections on record with the Heceta Water District.

i) Source: Number of people served was estimated as between 3500 and 4000 by the Heceta Water District.

j) Source: The City of Florence used 31.6 million cubic feet during 1985-1986. The difference between that consumption figure and present annual well production capacity of 29.3 million cubic feet equals 2.3 million cubic feet.

CONCLUSIONS

An aquifer must supply 50 percent or more of the drinking water for an area in order to receive designation as a sole source aquifer. Ground water supplies about 68% of the drinking water in the North Florence area. Furthermore, ground water partly recharges the one source of surface water used as drinking water. No feasible alternative sources to the North Florence Dunal Aquifer system exist in the area. Therefore, contamination of the aquifer would "create a significant hazard to public health."[1]

REFERENCES

1. Safe Drinking Water Act, Public Law 93-523.42 U.S.C. 300 et. seq.

2. Sole Source Aquifer Petition and related material received by the U.S. Environmental Protection Agency, Seattle, Washington, June 2, 1985 and July 30, 1985.

3. Federal Register, Volume 50, No. 219, November 13, 1985, p. 46828-46829.

4. Federal Register, Volume 51, No. 41, March 3, 1986, p. 7335.

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6. Christensen, R. and Rosenthal, G., 1982, North Florence Dunal Aquifer Study: Lane County and Lane Council of Governments, Eugene, Oregon, 174 p.

7. Roberts, B., 1987, Oregon Blue Book 1987-88, Secretary of State, Salem, Oregon, p. 353.

8. Schlicker, H. G.; Deacon, R. J.; Newcomb, R. C.; and Jackson, R. L., 1974, Environmental Geology of Coastal Lane County: Oregon Department of Geology and Mineral Industries, Bulletin 85, 116 p.

9. Personal communication with E. M. Baldwin, Professor of Geology at the University of Oregon, on July 30, 1987.

10. Personal communication with John Beaulieu, State Geologist of Oregon, on July 31, 1987.

11. Couch, R.; Cook, J.; Connard, G.; Troseth, S.; and Standing, W., 1980, Seismic Measurements of the Dunal Aquifer of Florence, Oregon, A Final Report of the Lane Council of Governments: Geophysics Group of the School of Oceanography at Oregon State University.

12. Cooper, W. S., 1958, Coastal Sand Dunes of Oregon and Washington: Geolgical Society of America, Memoir 72, 169 p.

13. Twenhofel, W. H., 1946. Mineralogical and Physical Composition of the Sands of the Oregon Coast from Coos Bay to the Mouth of the Columbia River: Oregon Department of Geology and Mineral Industries, Bulletin 30, 64 p.

14. Christensen, R., 1985, Phosphorus Acumulation in the Clear Lake Watershed: Lane County Land Management Division of the Department of Public Works, 81 p.

15. Kirby, R. A.; Strong, C. H.; Stoner, J. L.; and Chappell, J., 1979, Coastal Domestic Water Supply Study: Lane County Environmental Health Division, 93 p.

SOLE SOURCE DESIGNATIONS:
WHAT THEY DO AND DON'T MEAN

Q: What is a sole source aquifer?

A: A sole source aquifer is an aquifer designated by the Environmental Protection Agency (EPA) as the "sole or principal source" of drinking water for a given aquifer service area; that is, an aquifer which supplies 50 percent or more of the drinking water for that area.

Q: What does EPA mean by "federal financially assisted projects" when it talks about reviewing them before they can be built? Examples?

A: To use an absurd example, EPA would definitely not get involved if a retiree were to use the proceeds from his Social Security check to buy materials to build a tool shed in his backyard.

EPA would not get involved if a private citizen were to obtain a federally-assisted mortgage loan (e.g., through the VA or the FHA) to build a single family dwelling.

EPA would not get involved if the federal financial assistance had not been earmarked for a special project. Just because a local bank received what can loosely be interpreted as federal financial assistance from the Federal Reserve Board, that doesn't mean a developer who borrows money from that bank would be considered to be building a "federal financially assisted project."

However, EPA would get involved in an interstate highway project receiving Department of Transportation funds...a housing development partially funded by HUD...HUD block grant...or a municipal sewage treatment plant being funded by EPA itself.

Somewhat less obvious examples would be hypothetical situations like these:

- Using Department of Transportation funds to build a new garage or parking facility for municipal busses. EPA would want to make sure the run-off of oil and grease would not wind up in the aquifer.
- The proprietor of an electroplating plant using a Small Business Administration loan to expand his firm. EPA's concern would be the heavy metals that are the waste products of such an operation; again, EPA would want to make sure the electroplating wastes would not harm the aquifer.
- A collection of private family dwellings, each of them financed over a period of time by individual VA or FHA loans, in one location, where the net effect would be the same as if all the homes were being built at one time by a single infusion of federal funds.

Q: Isn't EPA guilty of inconsistency? On one hand, EPA is saying it will not review the proposed construction of a single family residence being built with FHA or VA loans; then, on the other hand, EPA is saying they will be reviewed if collectively they pose a threat to ground water. Where is the cut-off point? How many individual homes in one location is too much?

A: This is the hardest question to answer because it involves a "judgment call" on a case-by-case basis. There is no magic number when a collection of private homes begins to pose a threat to drinking water. It depends on several factors--geology, depth to ground water, and especially the location of these homes. A cluster of new homes directly over an aquifer is more of a threat to ground water than the same sized cluster located at the extremity of a drainage area.

The best way to answer this question is to say that whether EPA reviews a project does not depend on the amount of federal money involved or even the size of the project. The key determinant is the significance of the pollution from that project, and "significance" will be measured by the volume of pollution, the character of that pollution, and the location of the project in relation to the aquifer.

Q: Isn't sole source designation going to make EPA into "Big Brother" on land use questions? EPA decisions relate directly to land use, but land use is something that should be decided by people on the local level. Is that the way EPA wants it?

A: Land use is outside the scope and authority of the sole source review process. The federal government has no business making local land use decisions. Period.

Q: If EPA decides something cannot be built, is that decision final? How can people appeal an EPA decision?

A: If EPA says "no", they have several choices. The project proponent can, if financially able, decide to go it alone, without the federal funds. Or, they can redesign the project to accommodate the EPA objections. Or, if those two options are not viable, they can ask for judicial review in the U.S. Court of Appeals in the Ninth Circuit Court in San Francisco.

Q: Does this sole source procedure apply to projects built solely with federal funds for a federal agency? For example, if the U.S. Navy were to build a substantial housing development for Naval personnel, would that fall under a sole source review?

A: No. Projects of that type (direct federal projects) are excluded from the sole source review process. However, such a project would fall under the purview of state or regional water quality management programs and would have to conform with any local laws or ordinances.

Q: What about projects not funded at all by federal agencies? If there are projects to be built entirely with private funds and those projects threaten the ground water, what safeguards are there that the aquifer will be protected?

A: Strong state and local controls are the best method. The EPA sole source review process is not a panacea. EPA's authority is limited only to those projects receiving federal financial assistance.

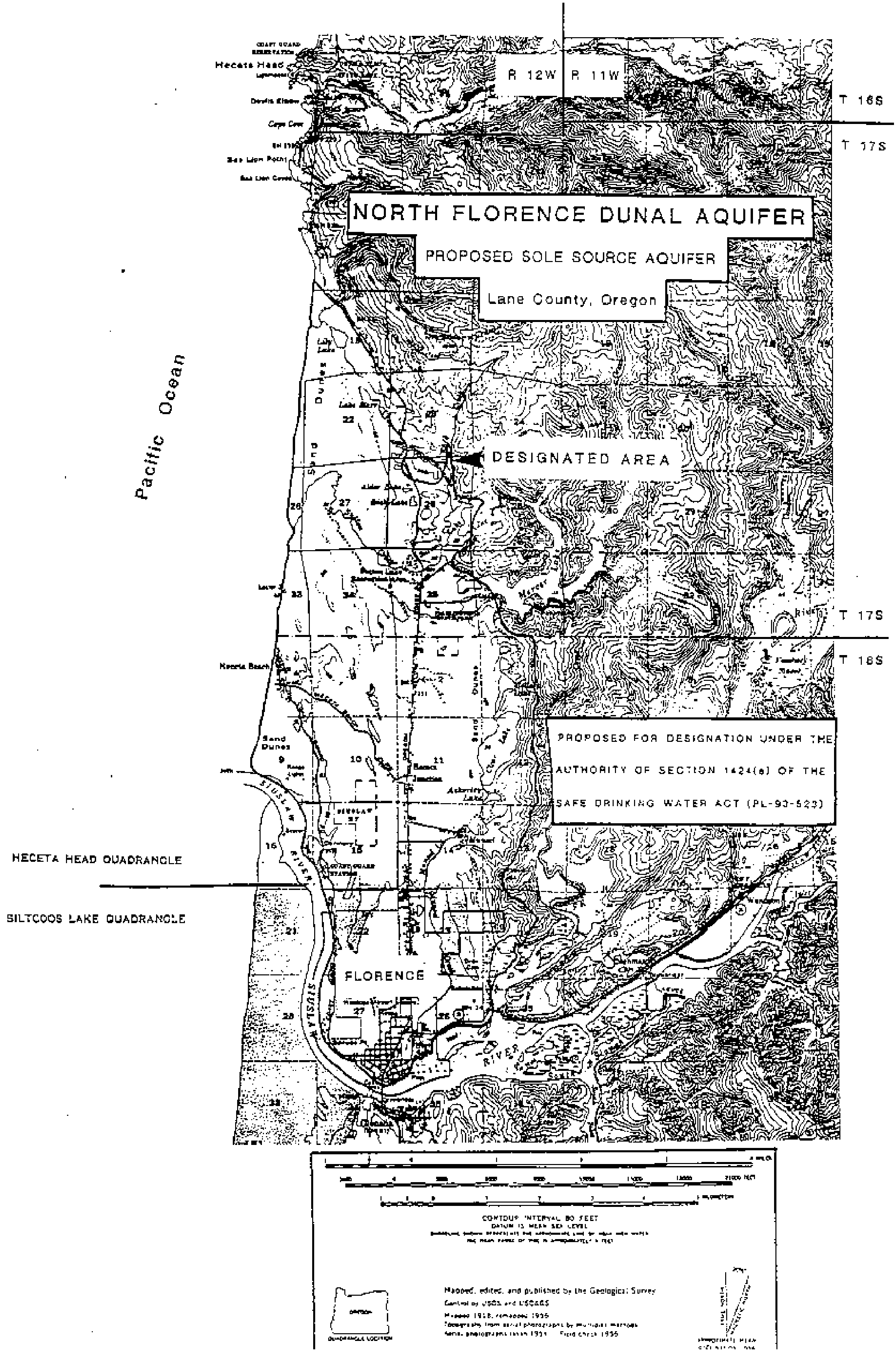
Q: What about federal financially assisted projects that have already received funding approval but where construction has not yet started? Are such projects covered by sole source review?

A: No. The sole source review is not retroactive. Any project where the federal financial assistance has been approved prior to the effective date of the designation is <u>not</u> subject to sole source review. However, if a project needs additional funding, the project to be built with those additional funds would be subject to the EPA evaluation.

ATTACHMENT 1

NORTH FLORENCE DUNAL AREA
PROPOSED SOLE SOURCE AQUIFER DESIGNATED AREA

MAP



NORTH FLORENCE DUNAL AQUIFER
PROPOSED SOLE SOURCE AQUIFER
Lane County, Oregon
DESIGNATED AREA
PROPOSED FOR DESIGNATION UNDER THE AUTHORITY OF SECTION 1424(e) OF THE SAFE DRINKING WATER ACT (PL-93-523)
R 12W
R 11W
T 16S
T 17S
T 17S
T 18S
Pacific Ocean
Heceta Head
Devils Elbow
Cape Cove
Sea Lion Point
Sea Lion Caves
Heceta Beach
Sand Dunes
Sand Dunes
SIUSLAW RIVER
SIUSLAW RIVER
FLORENCE
HECETA HEAD QUADRANGLE
SILTCOOS LAKE QUADRANGLE
CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL
Mapped, edited, and published by the Geological Survey
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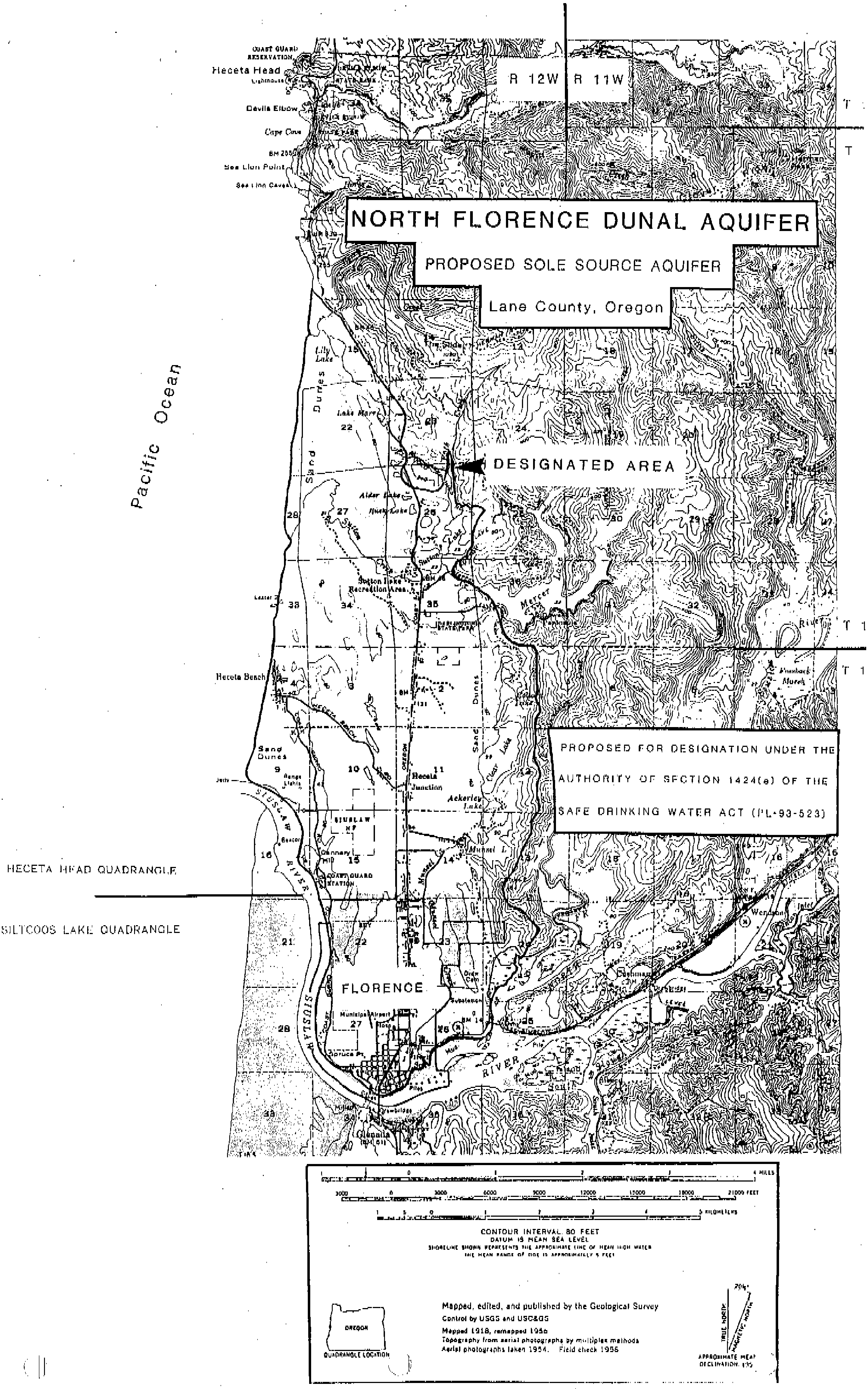

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R 11W
Pacific Ocean
Heceta Head
Devils Elbow
Cape Cove
Sea Lion Point
Sea Lion Caves
Lily Lake
Lake Marr
Alder Lake
Sand Dunes
Sutton Lake Recreation Area
Heceta Beach
Heceta Junction
Ackerley Lake
Munsel L.
Clear Lake
Mercer
FLORENCE
Municipal Airport
Spruce Pt.
Cushman
Wendson
Glenada
SIUSLAW RIVER
HECETA HEAD QUADRANGLE
SILTCOOS LAKE QUADRANGLE
CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL
Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Mapped 1918, remapped 1956
Topography from aerial photographs by multiplex methods
Aerial photographs taken 1954. Field check 1956
OREGON
QUADRANGLE LOCATION
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION