

**MISSOURI**  
DEPARTMENT OF  
NATURAL RESOURCES

Michael L. Parson  
Governor

Dru Buntin  
Director

February 14, 2023

Forbes Lake of the Ozarks Park  
26506 Gardiner Road  
Edwards, MO 65326

**RE: Forbes Lake of the Ozarks Park Residential Housing Development**

To Whom It May Concern:

From November 30, 2022 to December 6, 2022, four geologists with the Missouri Geological Survey conducted a geohydrologic evaluation of the 12,800 acre Forbes Lake of the Ozarks Park. The property is located east of Warsaw and south of Lake of the Ozarks. The purpose of the onsite evaluation was to observe the geologic and hydrologic characteristics at the proposed residential housing development and to determine potential impacts to the state’s water resources in the event of wastewater treatment failure.

The property has been subdivided into three zones based on the observed geologic and hydrologic characteristics. The following table summarizes the minimum lot size required for each zone with the designated water supply. A map showing the three zones follows this report.

<b>Geologic Zone</b>	<b>Water Supply</b>	<b>Minimum Lot Size</b>
Zone 1	Community Public Water Supply	3.6
Zone 1	Multifamily Wells or Individual Domestic Wells with Full Length Grout	4.0
Zone 1	Individual Domestic Wells	4.8
Zone 2	Community Public Water Supply	4.4
Zone 2	Multifamily Wells or Individual Domestic Wells with Full Length Grout	4.8
Zone 2	Individual Domestic Wells	5.0
Zone 3	Community Public Water Supply	5.0
Zone 3	Multifamily Wells or Individual Domestic Wells with Full Length Grout	5.0
Zone 3	Individual Domestic Wells	5.0

Surficial materials on the property have variable organic matter content but are routinely very gravelly silty clay below a thin layer of topsoil. The surficial materials are less than



five feet in thickness across the site, with many locations having zero to less than one foot of soil. These residual materials developed in place from the weathering of dolomite bedrock. They display moderate to high permeability. Due to the thinness and permeability of the surficial materials, the potential for effluent perching on lower permeability bedrock and surfacing is high.

Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones.

No karst features were identified in Zone 1, and only incipient dissolution, primarily along waterways and the lakeshore, was observed. Zone 2 includes all areas within one mile of observed karst features such as caves and sinkholes. Zone 3 has pervasive karst development. These karst features are conduits through which water or wastewater can rapidly recharge into the drinking water aquifer.

In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.

If you have any questions, please feel free to contact me at 573-368-2162 or via email at [molly.starkey@dnr.mo.gov](mailto:molly.starkey@dnr.mo.gov). The map of the geologic zones in the development and the completed forms for each zone and water supply are enclosed.

Sincerely,

MISSOURI GEOLOGICAL SURVEY

*Molly A. Starkey*

Molly Starkey, RG  
Environmental Assistance Unit

Enclosures

c: Chuck Harwood, Water Protection Program  
Kansas City Regional Office





**Missouri Department Of Natural Resources**  
 Missouri Geological Survey  
 Geological Survey Program  
 Environmental Geology Section

Project ID Number  
**RHD23034**  
 County  
**Benton County**

**Request Details**

Project: Forbes Lake Ozark Zone 1 -  
 Public Wells

Legal Description: 22 T40N R21W

Quadrangle: EDWARDS  
 Latitude: 38 13 41.54  
 Longitude: -93 14 11.19

Organization Official

Name: Forbes Environmental Control  
 Committee

Address: 26506 Gardiner Rd  
 City: Edwards  
 State: MO Zip: 65326  
 Phone: 660-438-4093  
 Email: ecc@forbesmo.org

Preparer

Name: Charles Harwood

Address: 1101 Riverside Dr  
 City: Jefferson City  
 State: MO Zip: 65101  
 Phone: 573-751-9155  
 Email: charles.harwood@dnr.mo.gov

**Project Details**

Report Date: 02/17/2023  
 Date of Field Visit: 11/30/2022  
 Project Exempt: No

Previous Reports: RHD23019  
 RHD23020  
 RHD23021  
 RHD23031

Upper Bedrock

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

Water Supply

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

Approximate Groundwater Velocity

- 0.0 Low to moderate
- 1.2 High

Surficial Materials Type

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

Surficial Material Thickness

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

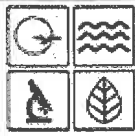
Watershed Hydrology

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

This evaluation is not an approval under the current residential housing development rules and pertains only to groundwater contamination potential. This report is valid for one year only at the location specified.

Minimum Lot Size:

Total of rating numbers for all categories equals minimum lot size in acres.



**Missouri Department Of Natural Resources**  
Missouri Geological Survey  
Geological Survey Program  
Environmental Geology Section

Project ID Number  
**RHD23034**  
County  
**Benton County**

**Remarks:**

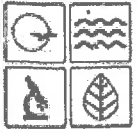
From November 30, 2022 to December 6, 2022, four geologists with the Missouri Geological Survey conducted a geohydrologic evaluation of the 12,800 acre Forbes Lake of the Ozarks Park. The property is located east of Warsaw and south of Lake of the Ozarks. The purpose of the onsite evaluation was to observe the geologic and hydrologic characteristics at the proposed residential housing development and to determine potential impacts to the state's water resources in the event of wastewater treatment failure.

Surficial materials on the property have variable organic matter content but are routinely very gravelly silty clay below a thin layer of topsoil. The surficial materials are less than five feet in thickness across the site, with many locations having zero to less than one foot of soil. These residual materials developed in place from the weathering of dolomite bedrock. They display moderate to high permeability. Due to the thinness and permeability of the surficial materials, the potential for effluent perching on lower permeability bedrock and surfacing is high.

Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. No karst features were identified in Zone 1, and only incipient dissolution, primarily along waterways and the lakeshore, was observed.

The minimum required lot size for lots served by a public water supply or community public water supply well is 3.6 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.



**Request Details**

**Project:** Forbes Lake Ozark Zone 1 - Individual Wells

**Legal Description:** 22 T40N R21W

**Quadrangle:** EDWARDS  
**Latitude:** 38 13 37.67  
**Longitude:** -93 14 12.73

**Organization Official**

**Name:** Forbes Environmental Control Committee  
**Address:** 26506 Gardiner Rd  
**City:** Edwards  
**State:** MO **Zip:** 65326  
**Phone:** 660-438-4093  
**Email:** ecc@forbesmo.org

**Preparer**

**Name:** Charles Harwood  
**Address:** 1101 Riverside Dr  
**City:** Jefferson City  
**State:** MO **Zip:** 65101  
**Phone:** 573-751-9155  
**Email:** charles.harwood@dnr.mo.gov

**Project Details**

**Report Date:** 02/17/2023  
**Date of Field Visit:** 11/30/2022  
**Project Exempt:** No

**Previous Reports:** RHD23019  
 RHD23020  
 RHD23021

**Upper Bedrock**

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

**Surficial Materials Type**

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

**Water Supply**

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

**Surficial Material Thickness**

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

**Approximate Groundwater Velocity**

- 0.0 Low to moderate
- 1.2 High

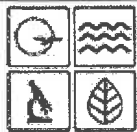
**Watershed Hydrology**

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

This evaluation is not an approval under the current residential housing development rules and pertains only to groundwater contamination potential. This report is valid for one year only at the location specified.

**Minimum Lot Size:**

Total of rating numbers for all categories equals minimum lot size in acres.



**Remarks:**

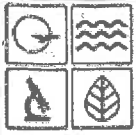
From November 30, 2022 to December 6, 2022, four geologists with the Missouri Geological Survey conducted a geohydrologic evaluation of the 12,800 acre Forbes Lake of the Ozarks Park. The property is located east of Warsaw and south of Lake of the Ozarks. The purpose of the onsite evaluation was to observe the geologic and hydrologic characteristics at the proposed residential housing development and to determine potential impacts to the state's water resources in the event of wastewater treatment failure.

Surficial materials on the property have variable organic matter content but are routinely very gravelly silty clay below a thin layer of topsoil. The surficial materials are less than five feet in thickness across the site, with many locations having zero to less than one foot of soil. These residual materials developed in place from the weathering of dolomite bedrock. They display moderate to high permeability. Due to the thinness and permeability of the surficial materials, the potential for effluent perching on lower permeability bedrock and surfacing is high.

Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. No karst features were identified in Zone 1, and only incipient dissolution, primarily along waterways and the lakeshore, was observed.

The minimum required lot size for individual domestic wells in this zone is 4.8 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.



**Missouri Department Of Natural Resources**  
 Missouri Geological Survey  
 Geological Survey Program  
 Environmental Geology Section

**Project ID Number**  
**RHD23033**  
**County**  
**Benton County**

**Request Details**

**Project:** Forbes Lake Ozark Zone 1 -  
 Multifamily Wells

**Legal Description:** 22 T40N R21W

**Quadrangle:** EDWARDS  
**Latitude:** 38 13 42.19  
**Longitude:** -93 14 11.87

**Organization Official**

**Name:** Forbes Environmental Control  
 Committee

**Address:** 26506 Gardiner Rd  
**City:** Edwards  
**State:** MO **Zip:** 65326  
**Phone:** 660-438-4093  
**Email:** ecc@forbesmo.org

**Preparer**

**Name:** Charles Harwood

**Address:** 1101 Riverside Dr  
**City:** Jefferson City  
**State:** MO **Zip:** 65101  
**Phone:** 573-751-9155  
**Email:** charles.harwood@dnr.mo.gov

**Project Details**

**Report Date:** 02/17/2023  
**Date of Field Visit:** 11/30/2022  
**Project Exempt:** No

**Previous Reports:** RHD23019  
 RHD23020  
 RHD23021  
 RHD23031

**Upper Bedrock**

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

**Surficial Materials Type**

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

**Water Supply**

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

**Surficial Material Thickness**

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

**Approximate Groundwater Velocity**

- 0.0 Low to moderate
- 1.2 High

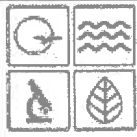
**Watershed Hydrology**

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

This evaluation is not an approval under the current residential housing development rules and pertains only to groundwater contamination potential. This report is valid for one year only at the location specified.

**Minimum Lot Size:**

Total of rating numbers for all categories equals minimum lot size in acres.



**Remarks:**

From November 30, 2022 to December 6, 2022, four geologists with the Missouri Geological Survey conducted a geohydrologic evaluation of the 12,800 acre Forbes Lake of the Ozarks Park. The property is located east of Warsaw and south of Lake of the Ozarks. The purpose of the onsite evaluation was to observe the geologic and hydrologic characteristics at the proposed residential housing development and to determine potential impacts to the state's water resources in the event of wastewater treatment failure.

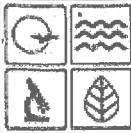
Surficial materials on the property have variable organic matter content but are routinely very gravelly silty clay below a thin layer of topsoil. The surficial materials are less than five feet in thickness across the site, with many locations having zero to less than one foot of soil. These residual materials developed in place from the weathering of dolomite bedrock. They display moderate to high permeability. Due to the thinness and permeability of the surficial materials, the potential for effluent perching on lower permeability bedrock and surfacing is high.

Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. No karst features were identified in Zone 1, and only incipient dissolution, primarily along waterways and the lakeshore, was observed.

The minimum lot size required for multifamily wells or individual domestic wells with full length grout is 4 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.





**Request Details**

**Project:** Forbes Lake Ozark Zone 2 -  
 Public Wells

**Legal Description:** 19 T40N R20W

**Quadrangle:** EDWARDS

**Latitude:** 38 13 31.57

**Longitude:** -93 11 22.2

**Organization Official**

**Name:** Forbes Environmental Control  
 Committee

**Address:** 26506 Gardiner Rd

**City:** Edwards

**State:** MO **Zip:** 65326

**Phone:** 660-438-4093

**Email:** ecc@forbesmo.org

**Preparer**

**Name:** Charles Harwood

**Address:** 1101 Riverside Dr

**City:** Jefferson City

**State:** MO **Zip:** 65101

**Phone:** 573-751-9155

**Email:** charles.harwood@dnr.mo.gov

**Project Details**

**Report Date:** 02/17/2023

**Previous Reports:** Not Applicable

**Date of Field Visit:** 11/30/2022

**Project Exempt:** No

**Upper Bedrock**

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

**Surficial Materials Type**

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

**Water Supply**

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

**Surficial Material Thickness**

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

**Approximate Groundwater Velocity**

- 0.0 Low to moderate
- 1.2 High

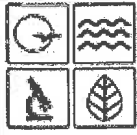
**Watershed Hydrology**

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

This evaluation is not an approval under the current residential housing development rules and pertains only to groundwater contamination potential. This report is valid for one year only at the location specified.

**Minimum Lot Size:**

Total of rating numbers for all categories equals minimum lot size in acres.



**Remarks:**

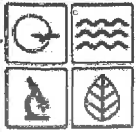
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Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. Zone 2 includes all areas within one mile of observed karst features such as caves and sinkholes.

The minimum required lot size for a public water supply well in Zone 2 is 4.4 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.



**Missouri Department Of Natural Resources**  
 Missouri Geological Survey  
 Geological Survey Program  
 Environmental Geology Section

**Project ID Number**  
**RHD23032**  
**County**  
**Benton County**

**Request Details**

**Project:** Forbes Lake Ozark Zone 2 - Individual Wells

**Legal Description:** 19 T40N R20W

**Quadrangle:** EDWARDS  
**Latitude:** 38 13 40.53  
**Longitude:** -93 11 28.56

**Organization Official**

**Name:** Forbes Environmental Control Committee

**Address:** 26506 Gardiner Rd  
**City:** Edwards  
**State:** MO **Zip:** 65326  
**Phone:** 660-438-4093  
**Email:** ecc@forbesmo.org

**Preparer**

**Name:** Charles Harwood

**Address:** 1101 Riverside Dr  
**City:** Jefferson City  
**State:** MO **Zip:** 65101  
**Phone:** 573-751-9155  
**Email:** charles.harwood@dnr.mo.gov

**Project Details**

**Report Date:** 02/17/2023

**Previous Reports:** Not Applicable

**Date of Field Visit:** 11/30/2022

**Project Exempt:** No

**Upper Bedrock**

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

**Surficial Materials Type**

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

**Water Supply**

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

**Surficial Material Thickness**

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

**Approximate Groundwater Velocity**

- 0.0 Low to moderate
- 1.2 High

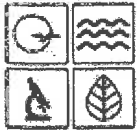
**Watershed Hydrology**

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

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**Minimum Lot Size:**

Total of rating numbers for all categories equals minimum lot size in acres.



**Missouri Department Of Natural Resources**  
Missouri Geological Survey  
Geological Survey Program  
Environmental Geology Section

**Project ID Number**  
**RHD23032**  
**County**  
**Benton County**

**Remarks:**

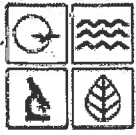
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Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. Zone 2 includes all areas within one mile of observed karst features such as caves and sinkholes.

The minimum required lot size for individual domestic wells in Zone 2 is 5 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.



**Missouri Department Of Natural Resources**  
 Missouri Geological Survey  
 Geological Survey Program  
 Environmental Geology Section

**Project ID Number**  
**RHD23035**  
**County**  
**Benton County**

**Request Details**

**Project:** Forbes Lake Ozark Zone 2 -  
 Multifamily Wells

**Legal Description:** 19 T40N R20W

**Quadrangle:** EDWARDS  
**Latitude:** 38 13 40.81  
**Longitude:** -93 11 25.85

**Organization Official**

**Name:** Forbes Environmental Control  
 Committee

**Address:** 26506 Gardiner Rd  
**City:** Edwards  
**State:** MO **Zip:** 65326  
**Phone:** 660-438-4093  
**Email:** ecc@forbesmo.org

**Preparer**

**Name:** Charles Harwood

**Address:** 1101 Riverside Dr  
**City:** Jefferson City  
**State:** MO **Zip:** 65101  
**Phone:** 573-751-9155  
**Email:** charles.harwood@dnr.mo.gov

**Project Details**

**Report Date:** 02/17/2023  
**Date of Field Visit:** 11/30/2022  
**Project Exempt:** No

**Previous Reports:** Not Applicable

**Upper Bedrock**

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

**Surficial Materials Type**

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

**Water Supply**

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

**Surficial Material Thickness**

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

**Approximate Groundwater Velocity**

- 0.0 Low to moderate
- 1.2 High

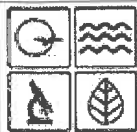
**Watershed Hydrology**

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

This evaluation is not an approval under the current residential housing development rules and pertains only to groundwater contamination potential. This report is valid for one year only at the location specified.

**Minimum Lot Size:**

Total of rating numbers for all categories equals minimum lot size in acres.



**Missouri Department Of Natural Resources**  
Missouri Geological Survey  
Geological Survey Program  
Environmental Geology Section

**Project ID Number**  
**RHD23035**  
**County**  
**Benton County**

**Remarks:**

From November 30, 2022 to December 6, 2022, four geologists with the Missouri Geological Survey conducted a geohydrologic evaluation of the 12,800 acre Forbes Lake of the Ozarks Park. The property is located east of Warsaw and south of Lake of the Ozarks. The purpose of the onsite evaluation was to observe the geologic and hydrologic characteristics at the proposed residential housing development and to determine potential impacts to the state's water resources in the event of wastewater treatment failure.

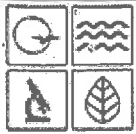
Surficial materials on the property have variable organic matter content but are routinely very gravelly silty clay below a thin layer of topsoil. The surficial materials are less than five feet in thickness across the site, with many locations having zero to less than one foot of soil. These residual materials developed in place from the weathering of dolomite bedrock. They display moderate to high permeability. Due to the thinness and permeability of the surficial materials, the potential for effluent perching on lower permeability bedrock and surfacing is high.

Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. Zone 2 includes all areas within one mile of observed karst features such as caves and sinkholes.

The minimum required lot size for individual domestic wells in Zone 2 is 5 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.

The minimum required lot size for multifamily wells or individual domestic wells with full length grout in Zone 2 is 4.8 acres. In the event of wastewater treatment failure, the local groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.



**Missouri Department Of Natural Resources**  
 Missouri Geological Survey  
 Geological Survey Program  
 Environmental Geology Section

**Project ID Number**  
**RHD23037**  
**County**  
**Benton County**

**Request Details**

Project: Forbes Lake Ozark Zone 3

Legal Description: 24 T40N R20W

Quadrangle: KNOBBY

Latitude: 38 13 35.1

Longitude: -93 4 58.5

**Organization Official**

Name: Forbes Environmental Control Committee

Address: 26506 Gardiner Rd

City: Edwards

State: MO Zip: 65326

Phone: 660-438-4093

Email: ecc@forbesmo.org

**Preparer**

Name: Charles Harwood

Address: 1101 Riverside Dr

City: Jefferson City

State: MO Zip: 65101

Phone: 573-751-9155

Email: charles.harwood@dnr.mo.gov

**Project Details**

Report Date: 02/17/2023

Previous Reports: RHD23025

Date of Field Visit: 11/30/2022

Project Exempt: No

**Upper Bedrock**

- 0.0 Surficial materials greater than 20 feet thick or bedrock generally displays low permeability
- 0.1 Bedrock has moderate to high near-surface relatively low permeability at depth
- 0.4 Bedrock has persistent open fractures and/or moderate to high permeability
- 1.2 Bedrock displays well developed karst features

**Surficial Materials Type**

- 0.0 Clay: Glacial drift or residuum with low permeability
- 0.1 Silt/Sand, Loess, silty and sandy alluvium, moderate permeability
- 0.4 Gravel: gravelly alluvium and residuum,
- 1.2 Macropore permeability: relict bedrock structure residuum

**Water Supply**

- 0.0 Community Public Water Supply
- 0.1 Non-community public water supply
- 0.4 Multi-family wells
- 1.2 Individual Domestic Wells

**Surficial Material Thickness**

- 0.0 Greater than 20 feet
- 0.1 Greater than 10 feet but less than or equal to 20 feet
- 0.4 Greater than 5 feet but less than or equal to 10 feet
- 1.2 Less than 5 feet

**Approximate Groundwater Velocity**

- 0.0 Low to moderate
- 1.2 High

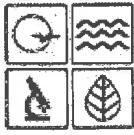
**Watershed Hydrology**

- 0.0 Limited recharge
- 0.4 Local recharge
- 1.2 Regional recharge

This evaluation is not an approval under the current residential housing development rules and pertains only to groundwater contamination potential. This report is valid for one year only at the location specified.

**Minimum Lot Size:**

Total of rating numbers for all categories equals minimum lot size in acres.



**Remarks:**

From November 30, 2022 to December 6, 2022, four geologists with the Missouri Geological Survey conducted a geohydrologic evaluation of the 12,800 acre Forbes Lake of the Ozarks Park. The property is located east of Warsaw and south of Lake of the Ozarks. The purpose of the onsite evaluation was to observe the geologic and hydrologic characteristics at the proposed residential housing development and to determine potential impacts to the state's water resources in the event of wastewater treatment failure.

Surficial materials on the property have variable organic matter content but are routinely very gravelly silty clay below a thin layer of topsoil. The surficial materials are less than five feet in thickness across the site, with many locations having zero to less than one foot of soil. These residual materials developed in place from the weathering of dolomite bedrock. They display moderate to high permeability. Due to the thinness and permeability of the surficial materials, the potential for effluent perching on lower permeability bedrock and surfacing is high.

Bedrock is found at the surface across much of the site. The observed bedrock formations are predominantly Ordovician-aged dolomites: The Jefferson City-Cotter Dolomite, the Roubidoux Formation, and the Gasconade Dolomite. Remnant channel sandstones of Pennsylvanian-age are found on some ridgetops. These sandstones are areally limited do no factor into the sitewide hydrology.

The dolomites have low to moderate primary permeability but high secondary permeability where dissolution along fractures, joints, and bedding planes has created karst features. The prevalence of the observed karst development is the basis upon which the site has been divided into geologic zones. Zone 3 has pervasive karst development. These karst features are conduits through which water or wastewater can rapidly recharge into the drinking water aquifer.

The minimum required lot size for all water supply sources in Zone 3 is 5 acres. In the event of wastewater treatment failure, the local, shallow, and regional groundwater as well as the surface waters of area streams and the Lake of the Ozarks may be adversely impacted.