DECLARATION

I, hereby declare that this thesis entitled **"Groundwater Modelling using WetSpass-M and MODFLOW"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Akansha V.R.

Place: Tavanur

Date: 24/02/2026

AKANSHA V R

(2023-18-002)

CERTIFICATE

Certified that this thesis entitled **"Groundwater Modelling using WetSpass-M and MODFLOW"** is a record of research work done independently by **Er. Akansha V R (2023-18-002)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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We, the undersigned members of advisory committee of **Er. Akansha V R (2023-18-002)**, a candidate for degree of **Master of Technology in Agricultural Engineering** with major in Soil and Water Conservation Engineering, agree that the thesis entitled **"GROUNDWATER MODELLING USING WETSPASS-M AND MODFLOW"** may be submitted by **Er. Akansha V R (2023-18-002)** in partial fulfilment of the requirement for the degree.

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Dedicated to my
parents and teachers

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LIST OF SYMBOLS AND ABBREVIATIONS

ASTER	:	Advanced Space-borne Thermal Emission and Reflection Radiometer
ArcGIS	:	Geographic Information System software by ESRI
CGWB	:	Central Ground Water Board
°C	:	Degree Celsius
DEM	:	Digital Elevation Model
DOI	:	Digital Object Identifier
EC	:	Electrical Conductivity
ET	:	Evapotranspiration
ET_0	:	Reference Evapotranspiration
ESRI	:	Environmental Systems Research Institute
FEFLOW	:	Finite Element subsurface FLOW system
GEE	:	Google Earth Engine
GIS	:	Geographic Information System
GW	:	Groundwater
h	:	Hydraulic head
H_0	:	Null hypothesis
H_1	:	Alternative hypothesis
h_1, h_2	:	Hydraulic heads at two points
IAHS	:	International Association of Hydrological Sciences
IDW	:	Inverse Distance Weighting
K	:	Hydraulic conductivity
K_{xx}, K_{yy}, K_{zz}	:	Hydraulic conductivity in x, y, and z directions
km	:	Kilometre
km^2	:	Square kilometre
LAI	:	Leaf Area Index
LULC	:	Land Use Land Cover
mm	:	Millimetre (used in rainfall, depth)
m	:	Metre
m/day	:	Metres per day

m^3	:	Cubic metre
m^3/day	:	Cubic metre per day
MK	:	Mann–Kendall test
MODFLOW	:	Modular Finite-Difference Groundwater Flow Model
MODFLOW Flex	:	Visual MODFLOW Flex
MODIS	:	Moderate Resolution Imaging Spectroradiometer
MT3D	:	Modular 3-Dimensional Transport Model
N	:	Number of observations
NDBI	:	Normalized Difference Built-up Index
NDVI	:	Normalized Difference Vegetation Index
n_e	:	Effective porosity
n	:	Porosity
NRMSE	:	Normalized Root Mean Square Error
PET	:	Potential Evapotranspiration
pH	:	Hydrogen ion concentration
Q	:	Groundwater Discharge
R	:	Groundwater recharge
R^2	:	Coefficient of determination
RMSE	:	Root Mean Square Error
RS	:	Remote Sensing
S_s	:	Specific storage coefficient
S_y	:	Specific yield
SWIR	:	Shortwave Infrared
SRTM	:	Shuttle Radar Topography Mission
USGS	:	United States Geological Survey
WetSpass	:	Water and Energy Transfer between Soil, Plants and Atmosphere under quasi-Steady State
WetSpass-M	:	Modified WetSpass Model
Z	:	Standardized Mann–Kendall test statistic
%	:	Percentage
µm	:	Micrometre