http://journal.uir.ac.id/index.php/JGEET

E-ISSN : 2541-5794
P-ISSN : 2503-216X

Journal of Geoscience, Engineering, Environment, and Technology
Vol xx No xx 20xx

RESEARCH ARTICLE

MCDA-AHP-GIS-Based Site Suitability Assessment for a Multi-Utility Tunnel in Panakkukang Sub-district, Makassar City

Ade Nirwani Abdurahman Muthalib [1,*], Nini Apriani Rumata[1], Fathurrahman Burhanuddin[1], Muhammad Faisal [2],Firdaus[1], Rahmania[3], Rizki Yusliana Bakti [2]

[1] *Department of Urban and Regional Planning, Universitas Muhammadiyah Makassar, Indonesia*
[2] *Department of Informatics, Universitas Muhammadiyah Makassar, Indonesia*
[3] *Department of Electrical Engineering, Universitas Muhammadiyah Makassar, Indonesia*

* Corresponding author: 105851100422@student.unismuh.ac.id
Tel.:+628-12-362-465-27
Received: Oct 1, 2016; Accepted: Nov 20, 2016.
DOI: 10.24273/jgeet.2016.1.2.001

Abstrak

This study develops a transparent MCDA–AHP–GIS framework to screen Multi-Utility Tunnel (MUT) corridor suitability in Panakkukang Sub-district, Makassar City, using 2024 baseline datasets and five criteria: utility/network density (C1), road functional class and corridor capacity (C2), flood susceptibility (C3), activity intensity (C4; proxied by kelurahan-level population density), and spatial planning compatibility with RTRW (C5). All layers were standardized and reclassified (1–3 or 1–5) and integrated using Weighted Linear Combination (WLC) with AHP-derived weights (CR = 0.028), where C1 (0.26) and C5 (0.24) were highest, followed by C2 (0.19), C4 (0.16), and C3 (0.15). The 2,918.3-ha study area was classified into Very Unsuitable (88.2 ha; 3.0%), Unsuitable (405.8 ha; 13.9%), Moderately Suitable (764.9 ha; 26.2%), Suitable (935.8 ha; 32.1%), and Highly Suitable (723.6 ha; 24.8%). A corridor-focused overlay shows that 436.9 ha fall within the Suitable–Highly Suitable mask, of which 127.3 ha (29.1%) intersect high flood-hazard zones, indicating that some priority segments require attention during detailed planning. Uncertainty mainly arises from buffer distances and reclassification thresholds and from non-differentiating attributes in some utility layers; however, a ±10% weight sensitivity test yields only minor shifts in class areas and preserves the main priority-corridor pattern.

Keywords: Multi-Utility Tunnel, GIS, MCDA-AHP, WLC, Land Suitability, Panakkukang Sub-district

1. Introduction

Rapid urban growth necessitates utility management that is more orderly, safe, and resilient to environmental disturbances. In many urban areas, utility installation using open-cut excavation is increasingly constrained because it can disrupt traffic, trigger land-use conflicts, and increase restoration and operation and maintenance costs (Bergman *et al.*, 2022; Z. Deng *et al.*, 2023; Thakre *et al.*, 2025). Fragmented development of electricity, telecommunications, potable water, and drainage networks often produces overlapping utilities, repeated excavation along the same road segments, and coordination challenges among agencies (Bergman *et al.*, 2022; Jorjam *et al.*, 2024; P. Zhang *et al.*, 2025). In this context, Multi-Utility Tunnels (MUT) provide an integrated underground corridor to accommodate multiple utilities, reducing re-excavation and improving service efficiency and resilience (Zhu and Zhang, 2025; Z. Deng *et al.*, 2023).

MUT implementation depends on corridor conditions particularly activity density, road functional class and capacity, and flood exposure which collectively influence utility integration requirements, construction feasibility, and long-term safety and performance (Zhang *et al.*, 2023; Peng, F. Le *et al.*, 2023; Oh *et al.*, 2025; Z. Deng *et al.*, 2023). Outside surface conditions, MUT corridor feasibility in Panakkukang is also influenced by subsurface geology dominated by Quaternary coastal alluvial deposits (Qac) and the Camba Formation (Tmc) (Center for Geological Research and Development, Bandung, 1982). The unconsolidated Qac unit is more prone to compressibility and differential settlement, while Tmc is relatively more competent but heterogeneous; therefore, priority segments especially within Qac-dominated zones should be verified through geotechnical and hydrogeological investigations at the detailed design stage. (Zhao *et al.*, 2022; Ullah *et al.*, 2024; Oh *et al.*, 2025). To integrate these interacting constraints, GIS-based MCDA–AHP is widely used to derive consistency-checked expert weights (CI/CR) and, through data standardization, proximity analysis, and multi-layer integration, generate regional suitability maps via weighted overlay (Faisal, Irmawati, *et al.*, 2025; Waheeb *et al.*, 2023; Ullah *et al.*, 2024; Mati *et al.*, 2021).

Integration between figures and text is demonstrated by the study area context in each figure