Stratigraphy, petroleum sedimentology, geochemistry **2 / 2026**

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INTEGRATED ANALYSIS OF GEOLOGICAL-GEOCHEMICAL AND HYDROGEOLOGICAL CONDITIONS AND GIS ASSESSMENT FOR REGIONAL PLANNING OF ECOLOGICAL INFRASTRUCTURE IN EASTERN GEORGIA

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Summary. Safe management and disposal of hazardous waste is a critical environmental and public health priority globally, and an urgent infrastructure need for Georgia. Despite ongoing industrial growth and environmental regulatory approximation with European Union standards, Georgia currently lacks a modern, engineered, compliant facility dedicated to hazardous waste landfilling. As a result, hazardous industrial byproducts are often stockpiled on-site in temporary storage facilities or in unlined municipal dumpsites, threatening regional water resources and public health.

This study presents a GIS-based multi-criteria evaluation for hazardous waste landfill site selection in Eastern Georgia, focusing on the Marneuli, Gardabani, and Tetritskaro municipalities. A multi-layer spatial database was assembled in a GIS environment, incorporating a 20-meter resolution Digital Elevation Model (DEM) and derived hillshade, 1:25,000 topographic map, 1:200,000 geological map, regional seismic hazard model, landslide and mudflow susceptibility maps, hydrological networks, infrastructural layers, and cadastral property boundaries. Adopting the environmental criteria framework developed by the European Bank for Reconstruction and Development, candidate locations were evaluated across 20 social, environmental, technical, and geological parameters. Each parameter was scored on an integer suitability scale from 1 to 5. Spatial screening identified 10 candidate locations. Aggregated multi-criteria scoring revealed three primary candidate sites: Marneuli (73), Tsintskaro (71), and Former Military Site (65).

This research establishes an empirical, objective decision-support baseline to guide the development of Georgia's first hazardous waste disposal facility, and outlines a comprehensive 6-phase GIS workflow for regional environmental infrastructure planning.

Keywords: *hazardous waste management, landfill site selection, Geographic Information Systems (GIS), Multi-Criteria Decision Analysis (MCDA), Eastern Georgia, environmental planning*

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Introduction

Rapid industrial expansion, urbanization, and technological modernization have generated substantial volumes of solid and hazardous waste globally (Kaza et al., 2018; Yatoo et al., 2024). While solid waste predominantly comprises biodegradable matter, paper, plastics, and inert debris, hazardous waste consists of industrial byproducts, toxic chemical residues, heavy metals, medical waste, and flammable, corrosive, or ecotoxic compounds that pose severe risks to public health and ecological equilibrium (Singh, 2022). Mismanagement of such wastes can lead to long-term environmental

degradation, notably the contamination of surface and groundwater resources through toxic leachate percolation, soil salinization, and atmospheric emissions of volatile organic compounds (Kareem et al., 2023).

In Georgia, the transition toward modern environmental governance and industrial alignment with international standards has highlighted hazardous waste management as a critical national issue (Chikhradze et al., 2025). Georgia generates diverse industrial, medical, and agricultural chemical wastes, primarily concentrated along the economic and industrial transport corridors encompassing Tbilisi, Rustavi, and surrounding municipalities (Buachidze et al., 2016; Buachidze et al., 2021).

Despite substantial regulatory progress under the European Union–Georgia association agreement and the adoption of the national Waste Management Code, Georgia does not yet possess a single modern, engineered, compliant facility dedicated to the disposal or long-term containment of hazardous waste. As a consequence of this infrastructure deficit, hazardous industrial residues are frequently stored within aging industrial premises. Moreover, wastes are stockpiled in temporary on-site holding units that lack adequate containment safeguards (Le Pavic et al., 2026).

Establishing a hazardous waste landfill is one of the most contentious and complex spatial planning tasks in environmental engineering. Landfill site selection requires balancing environmental, hydrogeological, engineering, economic, and socio-political constraints.

The integration of Geographic Information Systems (GIS) with Multi-Criteria Decision Analysis (MCDA) has become the gold standard (Vijay et al., 2005). GIS provides capabilities to capture, store, analyze, manipulate, and visually present disparate geospatial layers, ranging from satellite remote sensing data, digital elevation models (DEM), and hydrological streams to infrastructural networks and cadastral layouts (Chalkias, Lasaridi, 2011). Furthermore, MCDA techniques provide structured mathematical and operational frameworks to weight qualitative and quantitative decision parameters, reconcile competing objectives, and rank spatial alternatives (Gorsevski et al., 2012; Singh, 2019; Ali et al., 2023).

While international studies have frequently coupled GIS with the Analytic Hierarchy Process (AHP), Fuzzy AHP, Ordered Weighted Averaging (OWA), and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to allocate municipal solid waste sites, hazardous waste landfill siting requires specialized regulatory, engineering, and geohazard considerations (Chang et al., 2008; Wang et al., 2009; Nas et al., 2010; Khorsandi et al., 2019; Elkhrachy et al., 2023).

This study presents a GIS-based multi-criteria evaluation for hazardous waste landfill siting in Eastern Georgia, focusing on Marneuli, Gardabani, and Tetritskaro municipalities. Utilizing the systematic environmental criteria guidelines formulated by the European Bank for Reconstruction and Development, this study integrates 20 social, environmental, technical, and geological criteria across high-resolution spatial datasets.

Through an objective scoring framework, 10 candidate locations (see Fig. 1) are screened and ranked. The ultimate goal of this research is to resolve the infrastructural deficit in Georgia's hazardous waste sector by identifying geologically secure, environmentally robust, and socially acceptable candidate locations for future facility development.

Materials and Methods

Study area description

The study area is located in Eastern Georgia within the Kvemo Kartli region (see Table 1), encompassing sections of the Marneuli, Gardabani, and Tetritskaro municipalities, situated directly south and southeast of Tbilisi and adjacent to the industrial center of Rustavi. Geographically, this territory serves as a core logistical, industrial, and agricultural center of the South Caucasus.

The terrain ranges from flat alluvial plains and low-elevation semi-arid plateaus along the Mtkvari River basin to hilly terrain and structural cuestas formed by the foothills of the Lesser Caucasus (Tielidze, 2019). The regional climate is predominantly dry semi-arid to temperate continental, characterized by hot summers, moderately cold winters, and mean annual precipitation between 400 and 550 mm (Keggenhoff et al., 2014).

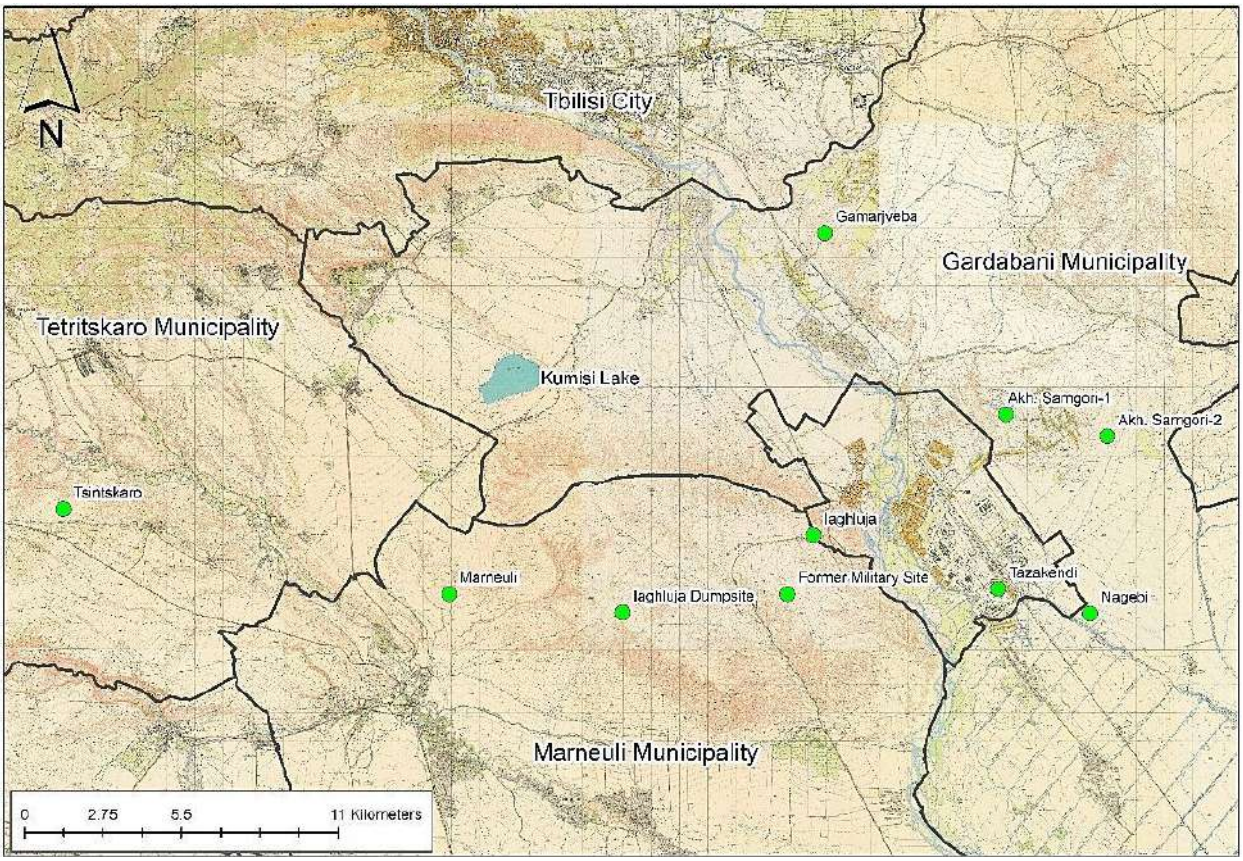

Fig. 1. Candidate sites on a 1:25,000 scale topographic map

The hydrographic network is controlled by the Mtkvari River and its key regional tributaries, including the Khrami and Algeti rivers, alongside enclosed water bodies such as Lake Kumisi. Groundwater configurations vary across the study territory: shallow water tables characterize the river floodplains, while deeper, confined, and semi-confined aquifers underlie the elevated structural plateaus, all these generalized information about groundwater levels were obtained from state hydrogeological maps. Land use is divided between irrigated agricultural farmlands, dry pastures, expanding suburban agglomerations, transport infrastructure, and heavy industrial installations in Rustavi.

Table 1

Coordinates of candidate sites (UTM -38N Zone)

X Coordinate	Y Coordinate	Location
498002	4608904	Gamarjveba
496697	4596234	Former Military Site
497595	4598289	Iaghluja
504354	4602529	Akhali Samgori-1
507911	4601769	Akhali Samgori-2
504094	4596407	Tazakendi
507314	4595547	Nagebi
471284	4599214	Tsintskaro
484819	4596234	Marneuli
490913	4595585	Iaghluja Dumpsite

Regional geological, tectonic and geohazard setting

As hazardous waste landfills require isolation from the biosphere across multi-decadal time horizons, the geological barrier represents the single most important safety component. The candidate territories are situated within the Marneuli structural block, which belongs to the weakly folded sedimentary cover of the Bolnisi subzone within the Artvin-Bolnisi tectonic zone of the Lesser Caucasus fold-and-thrust belt system (Adamia et al., 2017; Alania et al., 2026). Stratigraphically, the candidate sites sit atop two primary sedimentary suites: 1. Lower Oligocene Sakaraulo Stage (N_1^1sk): Dominated lithologically by thick molassic successions of arkosic and greywacke sandstones intercalated with thick layers of non-carbonate, jarosite-bearing, and gypsiferous clays. These dense clay layers exhibit low hydraulic conductivity and high clay mineral contents, offering natural impermeable containment properties. 2. Lower Miocene Maeotian-Pontian Stages (N_1^3m-p): Comprising thick clays and fine sandstones, occasionally interbedded with polymictic conglomerates. The dominant horizons provide natural attenuation barriers that prohibit downward migration of hazardous leachates (Gudjabidze et al., 1977).

Seismic hazards here are governed by the ongoing deformation within the Arabia-Eurasia convergence zone (Alania et al., 2018; Alania et al., 2022). According to the probabilistic seismic hazard and Peak Ground Acceleration (PGA) mapping for Georgia (Onur et al., 2020), the candidate locations fall within a uniform regional seismic zone characterized by a PGA reference value of 0.24 g (with a 10% exceedance probability in 50 years). Exogenous geological hazards, specifically landslide and mudflow susceptibility, were evaluated using regional geohazard inventories and topographic slope gradients. Hilly margins and dissected plateau slopes in Kvemo Kartli display moderate-to-high susceptibility to gravitational mass movements, whereas the low-gradient plateau surfaces and alluvial terraces exhibit low susceptibility.

Geospatial data acquisition and processing

Primary and secondary spatial datasets were processed using GIS software. A 1:25,000-scale topographic map was used to extract administrative boundaries, populated places, transport axes, and spot elevations. Cadastral land-registry polygons were integrated to identify public versus private land ownership boundaries and legal land use categories. A 20-meter spatial resolution Digital Elevation Model (DEM) was used to compute topographic surface metrics, including terrain slope, topographic aspect, and a hillshade model. These layers enabled the identification of low-gradient terrain to minimize excavation volumes and erosion risks. The 1:200,000 Geological Map of Georgia (Gudjabidze et al., 1977) was used to establish surface lithological units. Also, rivers, secondary channels, natural lakes and canals were mapped as polyline and polygon layers. Spatial layers were assembled for airfields/aerodromes, archaeological and cultural monuments, protected conservation territories (e.g. the Gardabani Managed Reserve), railways, and road arteries, while distance buffers of 500 meters were established around preliminary candidate locations to evaluate local isolation margins (See Fig. 4).

Multi-criteria Decision Analysis (MCDA) framework

The initial 10 candidate locations were empirically identified and validated through extensive field campaigns, including site assessments conducted during the EBRD project in 2024. In this study, the constraint and exclusion process is directly embedded within the scoring matrix; sites exhibiting critical environmental or technical deficiencies received minimum scores, effectively excluding them from final consideration and isolating the top-scoring locations. The model evaluates 20 discrete spatial parameters grouped into three main categories: social, environmental, and technical/geological (see Table 2). Candidate sites are assigned suitability rating scores for each parameter on an integer scale from 1 to 5.

Score 1 (poor) means that conditions pose severe environmental risks, direct social conflicts, or insurmountable technical barriers that cannot be mitigated by standard engineering practices. Score 2 (low suitability) represents that conditions are highly unfavorable and would require extensive engineering interventions or complex reclassifications to meet minimum safety standards. Score 3 (moderate) is

acceptable conditions but requires standard engineering adjustments or mitigations. Score 4 (High) means favorable conditions that naturally align with safety and operational requirements, requiring minimal technological intervention, while Score 5 (optimal) is the highest tier of suitability, providing maximum natural environmental containment, optimal logistical efficiency, and zero social or legal conflicts.

Results and Discussion

The scoring results clear distinction between the top three (Marneuli, Tsintskaro, Former Military Base) candidate sites (scores 65-73), while the remaining candidate locations scored 51-64. Akhali Samgori-2 (51 points), Akhali Samgori-1 (56 points), and Tazakendi (63 points) scored poorly across hydrogeological criteria. These locations are underlain by shallow water tables, lie close to drainage channels, and feature Quaternary alluvial gravels at the surface rather than impermeable bedrock. These conditions increase the vulnerability of regional aquifers to leachate migration. Nagebi (55 points) suffered from private landownership, inadequate area, irregular boundary geometry, and shallow groundwater conditions. Gamarjveba (56 points) showed limited contiguous area, close proximity to suburban development corridors, and surface exposures of alluvial formations. Iaghluja Dumpsite (64 points) and Iaghluja Plateau (60 points) provide impermeable soils, but scored lower due to poor road access, uneven morphology, complex local topography, and existing dumping operations.

Table 2

Multi-criteria evaluation parameters template for the candidate sites

Parameters	Basis of value selection (Score)		
	1-2	3	4-5
Type of access road	Track	Minor road	Main road
Distance to main road	>10 km	2-10 km	<2 km
Distance to railway sidings	>5 km	2-5 km	<2 km
Railway sidings on site	No	Possibly	Yes
Distance to power supply	>1 km	0.5-1 km	<500 m
Use of site by local population	Often	Moderate	No
Depth to aquifer	<10 m	10-50 m	>50 m
Distance to nearest surface water	<500 m	0.5-1 km	>1 km
Main ownership of land	Private	State	Owned
Current activities on site	Active	Possibly	No
Existing facilities on site	No	Some	Yes
Size (minimum 20 Ha)	Small	Adequate	Large
Topography	Steep	Moderate	Level
Landform	Uneven	Rough	Flat
Shape (length to breadth ratio)	Irregular	>3	1-2
Geological strata at surface	Alluvium	Rock	Clay
Chemically aggressive minerals	High	Moderate	Low
Susceptibility to flooding and erosion	High	Moderate	Low
Mineral resources on site	Definite	Possible	No
Mineral reserves permitted	Definite	Possible	No

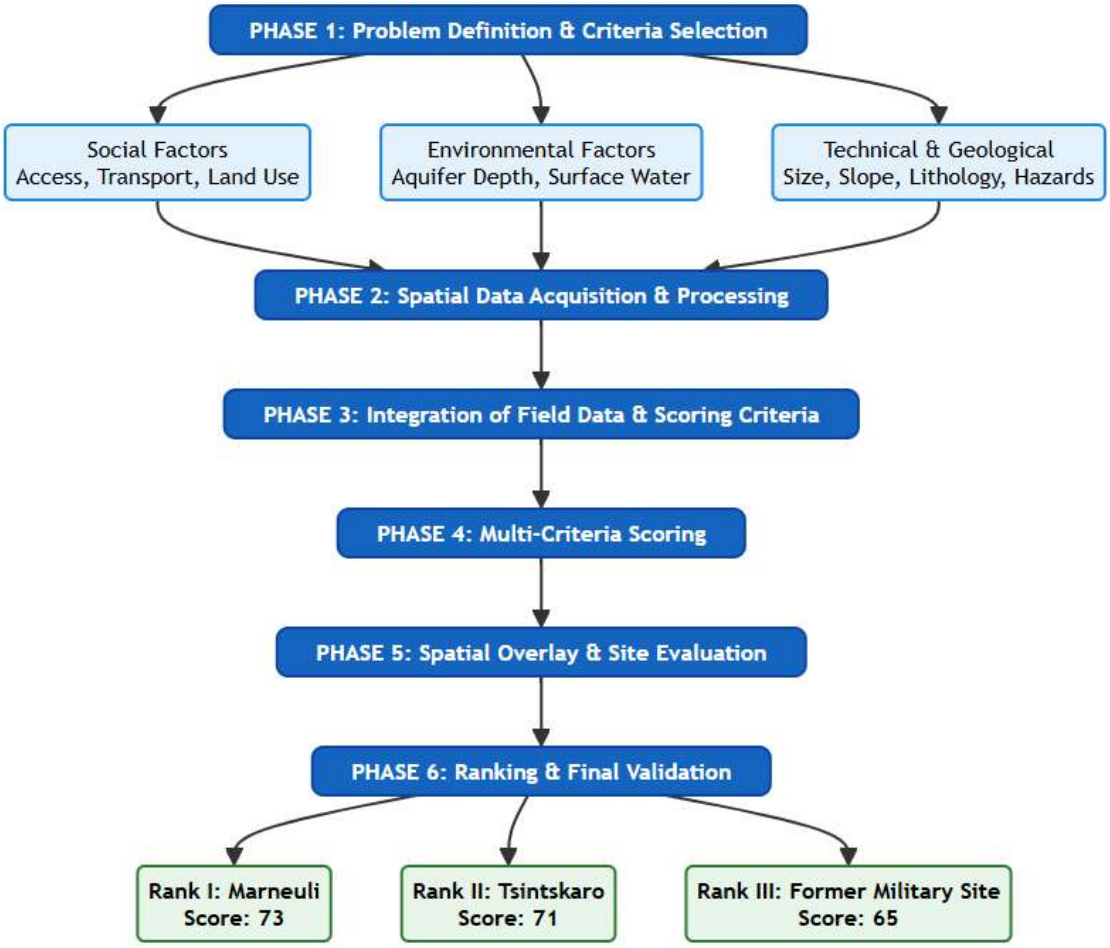

Fig. 2. A 6-phase GIS workflow for hazardous waste landfill siting

In this assessment, an unweighted linear additive scoring model was utilized, assigning equal mathematical weight to all 20 social, environmental, and technical parameters. Each criterion was scored strictly on a 1 to 5 scale, yielding a maximum theoretical site score of 100 (See Fig. 3). This unweighted approach was adopted to establish a transparent, objective screening baseline and to eliminate the subjective biases often associated with expert-assigned weighting frameworks. Consequently, the final rankings exhibit narrow numerical margins, particularly between the top-tier locations: Marneuli (73 points) and Tsintskaro (71 points).

Because of these small score differences, the specific ranking order of the top candidate sites is highly sensitive to minor parameter fluctuations; a 1- or 2-point adjustment in a secondary logistical parameter (such as access road quality or proximity to power supplies) could alter the sequential ranking of the top two sites. However, despite this mathematical sensitivity at the top of the ranking, the overall screening result remains appropriate. The clear separation between the top three candidate sites (65-73 points) and the lower-tier sites (51-64 points) is driven consistently by critical, high-impact environmental parameters. Sites that scored low were ultimately constrained by fundamental hydrogeological factors - such as shallow aquifers (<10 m) and permeable alluvial geology, which cannot be easily mitigated by engineering interventions. Therefore, while the precise 1st, 2nd, and 3rd place rankings may shift based on future detailed weighting, these three sites are definitively validated as the most secure locations for subsequent on-site geotechnical characterization and Environmental and Social Impact Assessments (ESIAs).

Evaluated Parameter	Marneuli	Tsintskaro	Former Military	Iaghluja Dumpsite	Tazakendi	Iaghluja	Akh. Samgori-1	Gamarjveba	Nagebi	Akh. Samgori-2
1. Access road type	3	3	1	2	5	2	3	3	4	3
2. Dist. to main road	4	4	3	3	5	4	4	4	5	4
3. Dist. to rail sidings	3	3	1	1	4	1	3	3	4	2
4. Rail sidings on site	1	1	1	1	1	1	1	1	1	1
5. Dist. to power supply	4	4	3	4	4	3	4	4	4	4
6. Site use by population	5	3	3	2	3	3	4	4	3	3
7. Depth to aquifer	3	3	3	3	1	3	2	2	1	1
8. Dist. to surface water	4	4	4	4	1	4	1	1	1	1
9. Land ownership	5	3	3	5	3	3	1	3	0	1
10. Current site activities	4	4	3	2	3	3	3	3	3	3
11. Existing facilities	1	1	3	1	1	1	1	1	1	1
12. Size (≥ 20 ha)	5	5	5	3	4	5	5	3	0	2
13. Topography (Slope)	3	5	4	4	4	3	3	3	4	3
14. Geomorphology	3	4	4	4	4	2	2	2	2	3
15. Geometric shape	4	4	4	4	4	2	3	4	0	3
16. Surface geology	4	3	4	4	1	4	1	1	4	1
17. Aggressive minerals	3	3	3	3	3	3	3	3	3	3
18. Flood/erosion risk	4	5	3	4	4	3	4	3	3	4
19. Mineral resources	5	5	5	5	4	5	4	4	5	4
20. Permitted reserves	5	5	5	5	4	5	4	4	5	4
Total Aggregated Score	**73**	**71**	**65**	**64**	**63**	**60**	**56**	**56**	**55**	**51**

Fig. 3. Full multi-criteria scoring matrix for all candidate locations

Conclusion

Our study applied a GIS-based multicriteria evaluation framework (See Fig. 2) to select suitable landfill sites for hazardous waste disposal in Eastern Georgia, focusing on the Marneuli, Gardabani, and Tetritskaro municipalities. As mentioned above, by integrating 20 social, environmental, technical, and geological criteria based on the EBRD guidelines, 10 candidate locations were screened and ranked.

Marneuli site (Rank I, Score: 73) is the optimal candidate location. Key advantages include designated non-agricultural land status, full state ownership, large area, direct access to paved transport arteries, an impermeable substrate of Maeotian-Pontian clays, and compatible land use legal status.

Tsintskaro site (Rank II, Score: 71) is also a strong candidate featuring level terrain, low erosional risks, a deep aquifer, thick impermeable Sakaraulo clay strata, and co-location within an established industrial waste corridor (adjacent to a regional municipal landfill and industrial explosives plant), though it requires agricultural land reclassification.

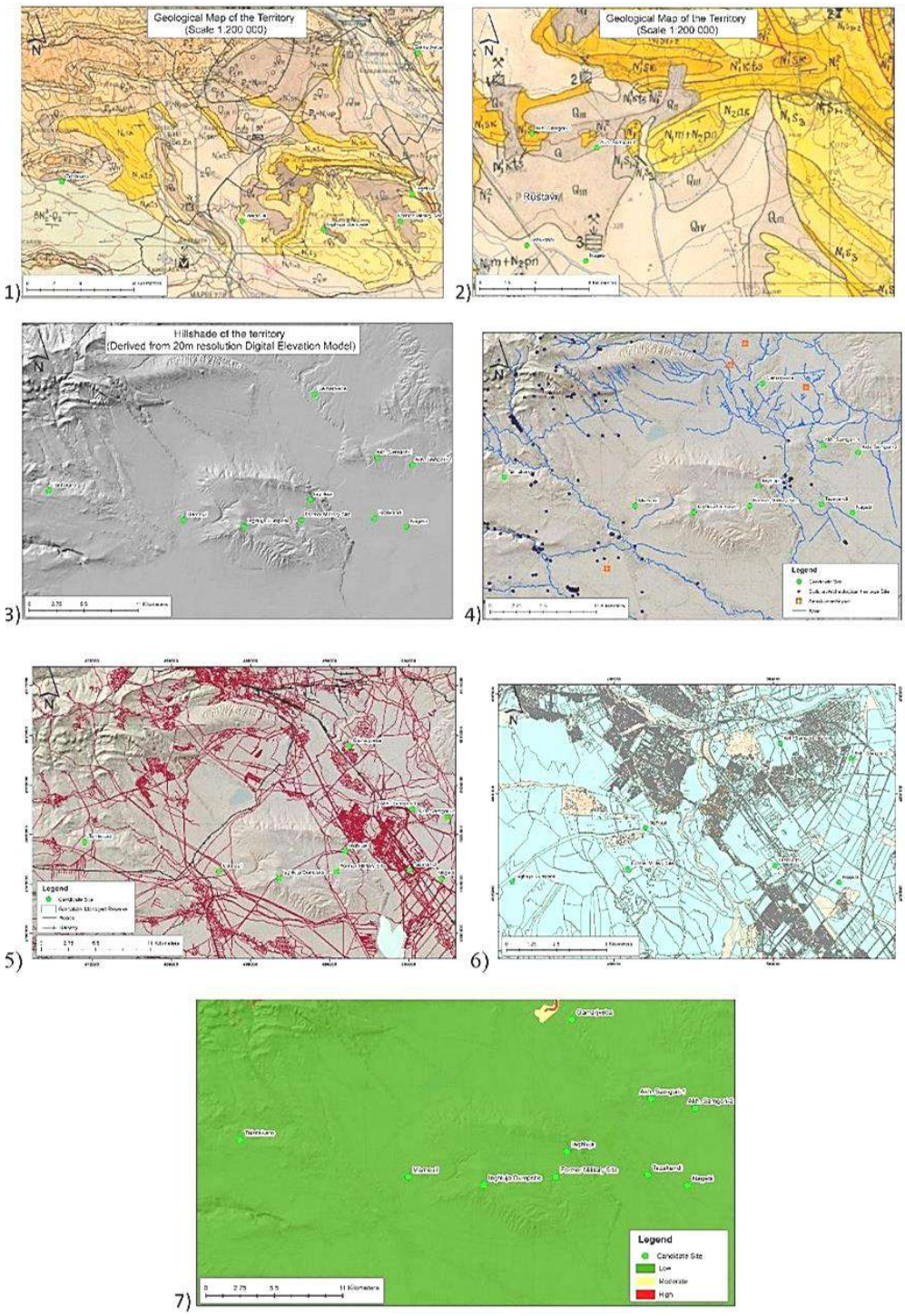

Fig. 4. 1) and 2) 1:200,000 scale geological maps; 3) Hillshade derived from a 20-meter resolution DEM; 4) Airports, cultural heritage sites and hydrographic network; 5) Protected area, road and railway systems; 6) Landownership; 7) Geohazard zoning

Former Military site (Rank III, Score: 65) is a viable candidate offering the largest buffer distance to residential settlements (3.7 km) and direct on-site railway system connections, though it requires road surface upgrades.

These results offer an empirical, scientifically grounded roadmap for policymakers, environmental engineers, and international financial institutions. Prior to final site commissioning, next steps must focus on detailed geotechnical borehole drilling and in-situ hydraulic conductivity testing across the top-ranked candidate locations, comprehensive site-specific Environmental and Social Impact Assessments (ESIAs), structural seismic design of multi-barrier containment cells calibrated to the local (0.24 g) PGA hazard parameter,

and transparent public consultation processes to build community engagement and trust.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

A.G. and K.C. conceived of the presented idea. A.G. took the lead in writing the manuscript. K.C. and B.K. reviewed and edited the manuscript. A.G. processed all visual materials. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

Acknowledgement: The authors would like to thank the Editor-in-Chief, the reviewer and Ms. Samira Malikova for their helpful and constructive comments and suggestions throughout the review process.

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ИНТЕГРАЛЬНЫЙ АНАЛИЗ ГЕОЛОГО-ГЕОХИМИЧЕСКИХ И ГИДРОГЕОЛОГИЧЕСКИХ УСЛОВИЙ И ГИС-ОЦЕНКА ПРИ РЕГИОНАЛЬНОМ ПЛАНИРОВАНИИ ЭКОЛОГИЧЕСКОЙ ИНФРАСТРУКТУРЫ ВОСТОЧНОЙ ГРУЗИИ

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Резюме. Безопасное обращение с опасными отходами и их захоронение представляют собой критически важный глобальный приоритет в сфере охраны окружающей среды и общественного здравоохранения, а также острую инфраструктурную потребность для Грузии. Несмотря на продолжающийся промышленный рост и гармонизацию экологического законодательства со стандартами Европейского Союза, в настоящее время в Грузии отсутствует современный, инженерно оборудованный и соответствующий нормативным требованиям

полигон, предназначенный для захоронения опасных отходов. В результате опасные побочные продукты промышленного производства зачастую складируются непосредственно на территориях предприятий во временных хранилищах или на неизолированных муниципальных свалках, что создает угрозу региональным водным ресурсам и здоровью населения.

В исследовании рассматривается комплексный подход с использованием геоинформационных систем (ГИС) для определения оптимального местоположения полигона опасных отходов в восточной части Грузии, уделяя особое внимание муниципалитетам Марнеули, Гардабани и Тетрицкаро. В геоинформационной системе (ГИС) был сформирован комплекс пространственных данных, объединивший цифровую модель рельефа (ЦМР) с разрешением 20 метров и полученную на её основе модель затенения рельефа, топографическую карту масштаба 1:25 000, геологическую карту масштаба 1:200 000, региональную модель сейсмической опасности, карты распространения оползневых и селевых процессов, гидрографическую сеть, данные об инфраструктуре, а также кадастровые границы земельных участков.

С применением системы экологических критериев, разработанной Европейским банком реконструкции и развития (ЕБРР), потенциальные участки были оценены по 20 социальным, экологическим, техническим и геологическим параметрам. Для каждого параметра использовалась пятибалльная система оценки степени пригодности. В результате пространственного анализа было выявлено 10 потенциальных участков. На основе комплексной оценки по совокупности критериев определены три приоритетные площадки: Марнеули (73 балла), Цинцкаро (71 балл) и территория бывшего военного объекта (65 баллов).

Результаты исследования обеспечивают научно обоснованную и объективную информационную базу для принятия решений относительно размещения первого в Грузии объекта захоронения опасных отходов. Кроме того, в работе представлен комплексный пятиэтапный алгоритм на основе ГИС, предназначенный для регионального планирования объектов экологической инфраструктуры.

Ключевые слова: *обращение с опасными отходами, определение местоположения полигона захоронения отходов, геоинформационные технологии (ГИС), система критериев выбора оптимального участка, Восточная Грузия, территориальное экологическое планирование*

ŞƏRQİ GÜRCÜSTANDA EKOLOJİ İNFRASTRUKTURUN REGİONAL PLANLAŞDIRILMASINDA GEOLOJİ-GEOKİMYƏVİ VƏ HİDROGEOLOJİ ŞƏRAİTİN KOMPLEKS TƏHLİLİ VƏ CİS QİYMƏTLƏNDİRİLMƏSİ

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Xülasə. Təhlükəli tullantıların etibarlı idarə olunması və utilizasiyası qlobal miqyasda ətraf mühitin və ictimai sağlamlığın qorunması baxımından mühüm prioritet, Gürcüstan üçün isə təxirəsalınmaz infrastruktur ehtiyacıdır. Davam edən sənaye artımına və ekoloji tənzimləmələrin Avropa İttifaqı standartlarına uyğunlaşdırılmasına baxmayaraq, hazırda Gürcüstanda təhlükəli tullantıların basdırılması üçün nəzərdə tutulmuş müasir, mühəndis-texniki cəhətdən təchiz edilmiş və normativ tələblərə cavab verən xüsusi obyekt mövcud deyil. Nəticədə, sənaye mənşəli təhlükəli yan məhsullar çox vaxt müəssisələrin ərazisində müvəqqəti saxlama sahələrində və ya izolyasiyaedici qatı olmayan bələdiyyə tullantı sahələrində toplanır ki, bu da regional su ehtiyatları və ictimai sağlamlıq üçün təhlükə yaradır.

Bu tədqiqat Şərqi Gürcüstanda, Marneuli, Qardabani və Tetritskaro bələdiyyələrini əhatə etməklə, təhlükəli tullantı poliqonu üçün sahə seçiminə dair Coğrafi İnformasiya Sistemlərinə (CİS) əsaslanan çoxmeyarlı qiymətləndirməni təqdim edir. CİS mühitində 20 metr məkan ayırdetməsinə malik Rəqəmsal Yüksəklik Modeli (RYM) və ondan əldə edilmiş kölgələndirilmiş relyef modeli, 1:25 000 miqyaslı topoqrafik xəritə, 1:200 000 miqyaslı geoloji xəritə, regional seysmik təhlükə modeli, sürüşmə və sel hadisələrinə meyillilik xəritələri, hidroloji şəbəkələr, infrastruktur layları və kadastr mülkiyyət sərhədlərini birləşdirən çoxlaylı məkan məlumatları bazası yaradılmışdır. Avropa Yenidənqurma və İnkişaf Bankı tərəfindən hazırlanmış ekoloji meyarlar çərçivəsi əsasında namizəd sahələr 20 sosial, ekoloji, texniki və geoloji parametr üzrə qiymətləndirilmişdir. Hər bir parametr 1-dən 5-dək tam ədədlərdən ibarət yararlılıq şkalası üzrə

qiymətləndirilmişdir. Məkan skrininqi nəticəsində 10 namizəd sahə müəyyən edilmişdir. Ümumiləşdirilmiş çoxmeyarlı qiymətləndirmə nəticəsində üç əsas namizəd sahə müəyyən olunmuşdur: Marneuli (73), Tsintskaro (71) və Keçmiş Hərbi Sahə (65).

Bu tədqiqat Gürcüstanda təhlükəli tullantıların basdırılması üçün ilk xüsusi obyektin yaradılmasına istiqamət verən qərarların qəbulunu dəstəkləmək məqsədilə empirik və obyektiv baza formalaşdırır və regional ekoloji infrastrukturun planlaşdırılması üçün hərtərəfli 6 mərhələli CİS iş axınını təqdim edir.

Açar sözlər: *təhlükəli tullantıların idarə olunması, tullantıların basdırılması poliqonunun yerləşmə yerinin müəyyən edilməsi, coğrafi informasiya sistemləri (CİS), optimal sahənin seçilməsi meyarları sistemi, Şərqi Gürcüstan, ərazi üzrə ekoloji planlaşdırma*