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FIG and the Association of Polish Surveyors, SGP have the honour to invite you to the FIG Congress 2022 ***11-15 September 2022*** in ***Warsaw, Poland*** at DoubleTree by Hilton Hotel & Conference Centre Warsaw.

LANDFILL SITE SCEENING AND SUITABILITY ASSESSMENT BASED ON AFFECTED COMMUNITY VIEWS

CASE STUDY IN THE TARKWA MINING AREAS OF GHANA

Presented by E. A. A. KWESI

OUTLINE OF PRESENTATION

- Introduction
- Study Area
- Materials/Methods
- Results/Discussions
- Conclusions/Recommendations

INTRODUCTION

- **Crude Land filling (by open dumping) continues as the most common, easy and affordable waste disposal method by communities in Ghana and other developing countries.**

- **Internationally acceptable and safe way of doing this is to shift to engineered landfilling but this is also faced with challenges such as meeting stringent regulatory requirements and Community Resistance in the selection and use of suitable sites.**

- **This paper discuses and demonstrates how these may be met at the local level, using "SMSA" MCDA and "POS" as Scientific Tools in Simple Practical Terms. A case study is used with "TMA" as study area.**

STUDY AREA

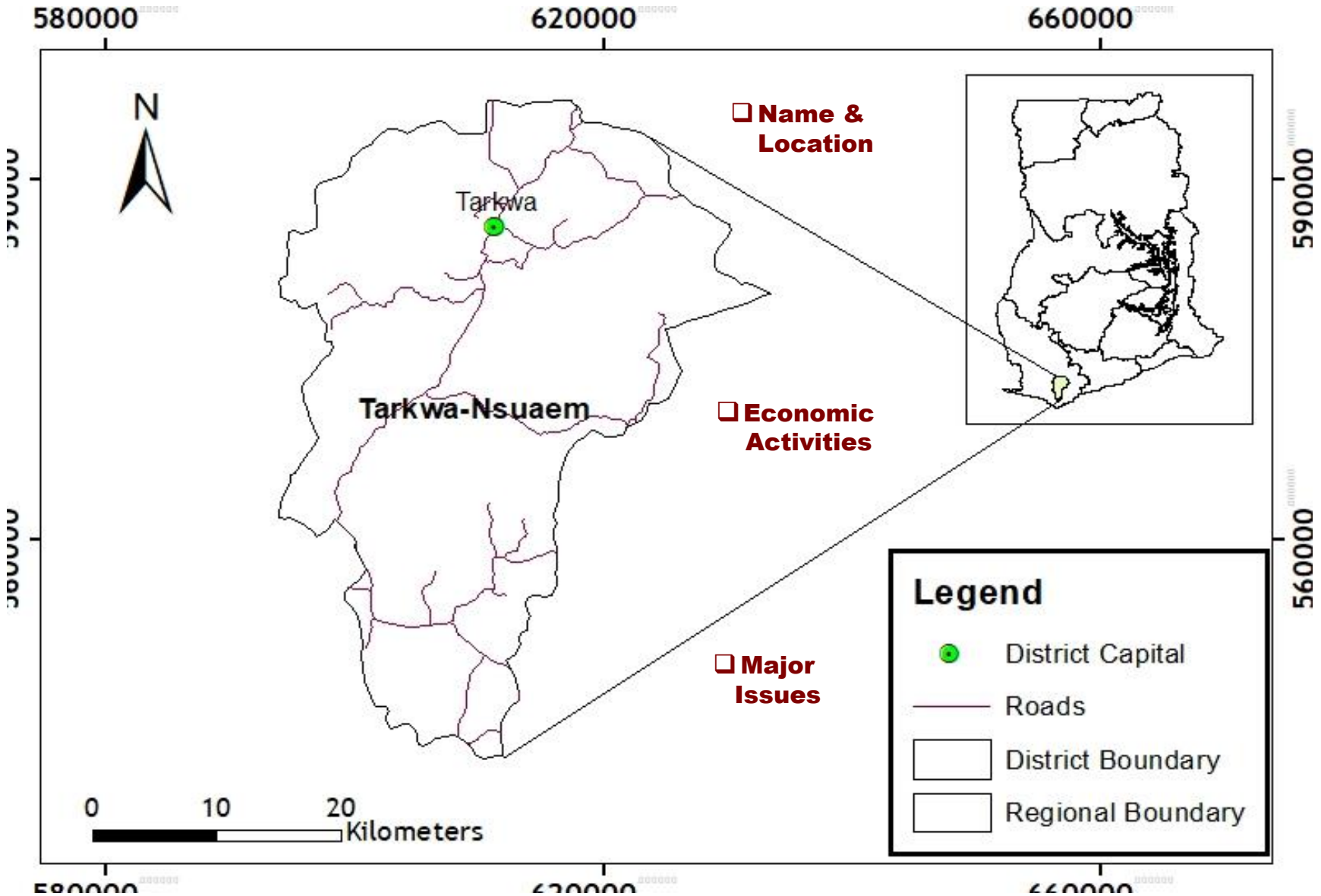

Fig. 1 Map Showing Location of Study Area

Study Area (Cont')

- **Topography**: Generally rugged with mountain ranges covered by thick forest and interspersedby undulating valleys

- **Geology/Hydrogeology** (Fig 2):
  - Located in the forest disserted plateau region of Ghana;
  - Birimian and Tarkwaian rocks dominate underlying geology;
  - Area is faulted and jointed

- **Soils:** Deep, open and acidic in many places

- **Groundwater**: Potential for occurrence and contamination from pollutants is higher in the Tarwaian than the Birimian rocks

- **Land Use/Acquisition Problems**: This is a major problem in landfill site selection due to mining, land conflicts and community opposition

Study Area (Cont')

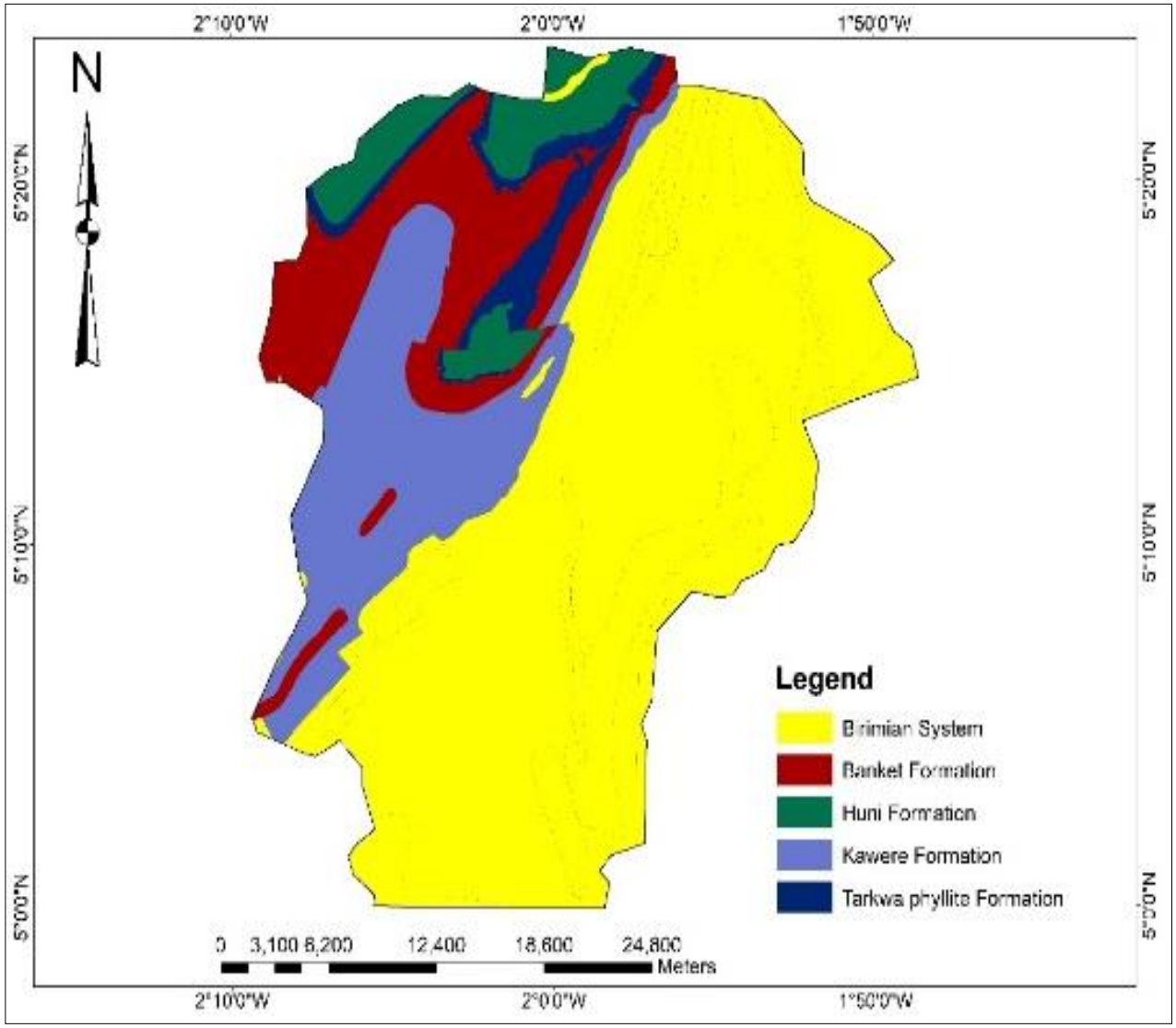

Fig. 2 Geology of Map of Study Area (simplified)

Study Area (Cont')

Fig. 3 Example of Crude Landfilling Situation in Study Area

MATERIALS AND METHODS

- **Field Materials**:- hand-held GPS receivers, digital cameras, tapes, field books, interviews/questionnaire sheets, etc.
- **Office Materials**:- computers, scanners, printers, etc.
- **Software**:- microsoft office suite, photoshop CS4, ArcGIS,
- **Data**:- coordinates of the waste dumps, town layout plans, topographic, geology, soil, land use/cover maps, field photos and extracts from interviews, questionnaire and other observational and field records.
- **Methods**:- review of relevant literature and documents, interviews and discussions with relevant stakeholders, field visits and observations, questionnaire, construction of GIS database, generation and analysis of site screening and suitability maps, host community survey results, etc.

Methods Used (Cont')

(a) GIS Application Approach

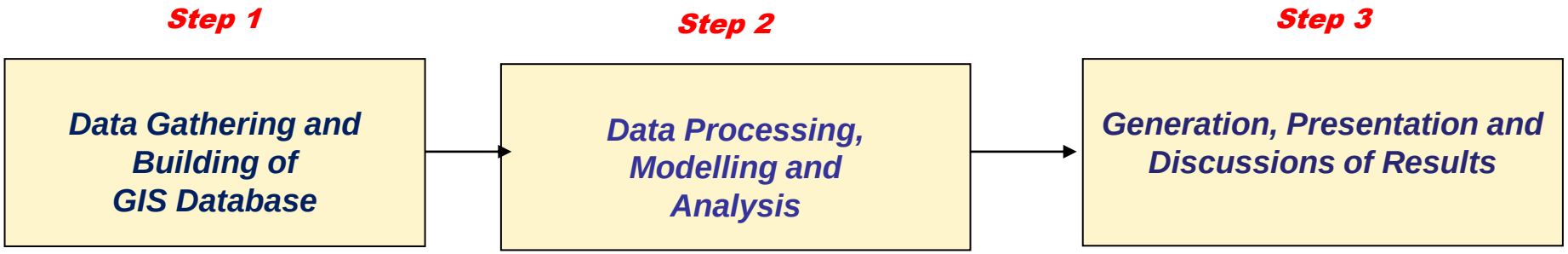

Fig. 3 Three-Steps Process Applied in the GIS-Based Site Selection Project

(b) Decision Modelling Steps

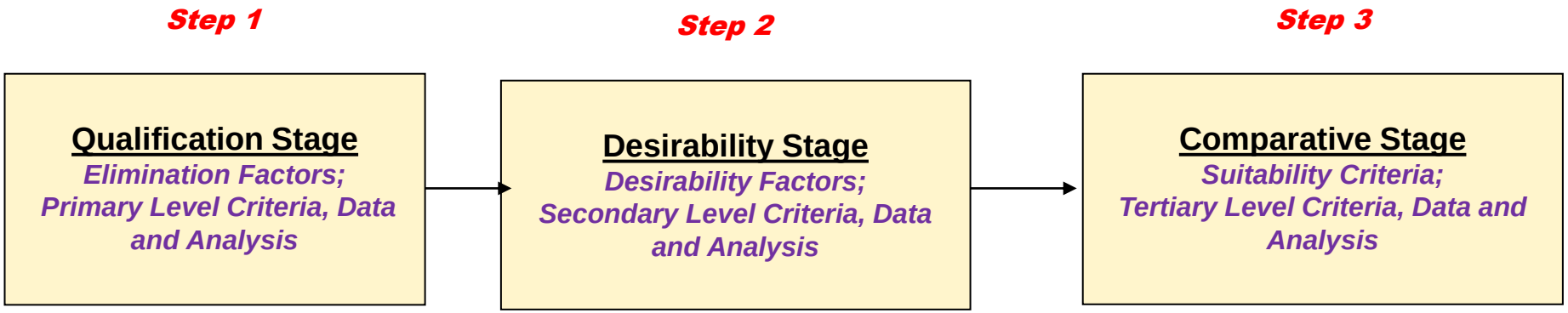

Fig. 4 Three-Steps Process Applied in the Site Selection Decision Making Analysis

Methods Used (Cont')

Table 1 Sample of Site Selection Criteria and Buffer Zones Used

Criterion Factors/Elements	Restrictions Related to Criterion Element Based on Regulatory Requirements	Criteria Applied
Land use (e. g. Residential Areas)	Areas within 500 m of residential and other sensitive land-uses	500 m buffer for residential, 200 m buffer for cemeteries and 300 m for active mining areas.
Land-cover (e. g. Forests Reserves)	Areas within 300-500 m of reserves and other properties	300 m buffer
Surface Water Bodies (e.g. Rivers)	Areas within 90-360 m of rivers, lakes, ponds, dams, wells, and springs	400 m buffer was used for important wells and 500 m buffer around other important water bodies
Roads/ Railways	Areas within 100-200 m of public transport and import utility lines	200 m buffer
Slope	Areas with slopes $\leq 2\%$ and $\geq 10\%$	slopes $\leq 2\%$ and $\geq 10\%$

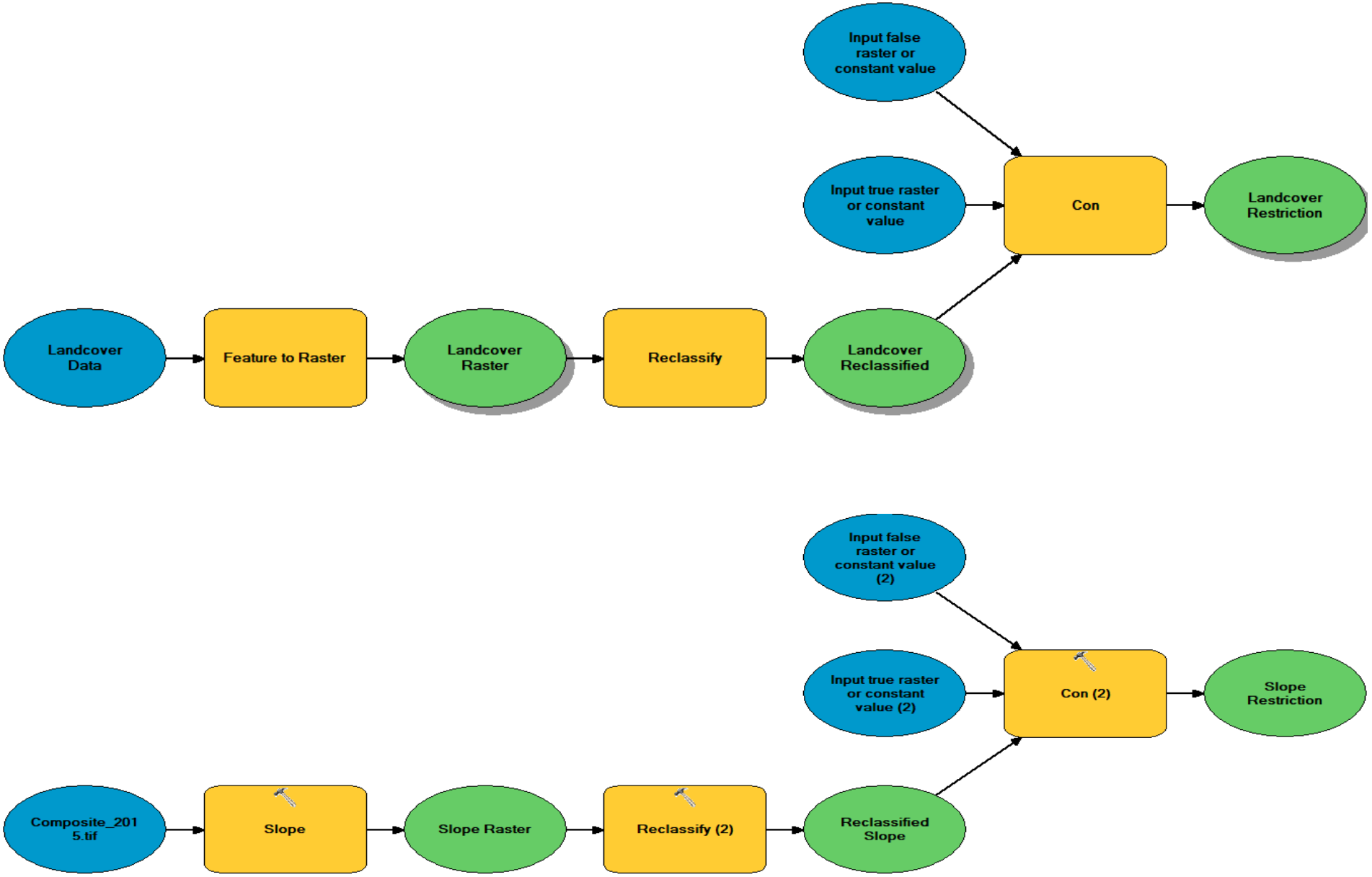

Fig 5a Site Screening Models for Land Cover/Use, Slope and Similar Area-based Criteria

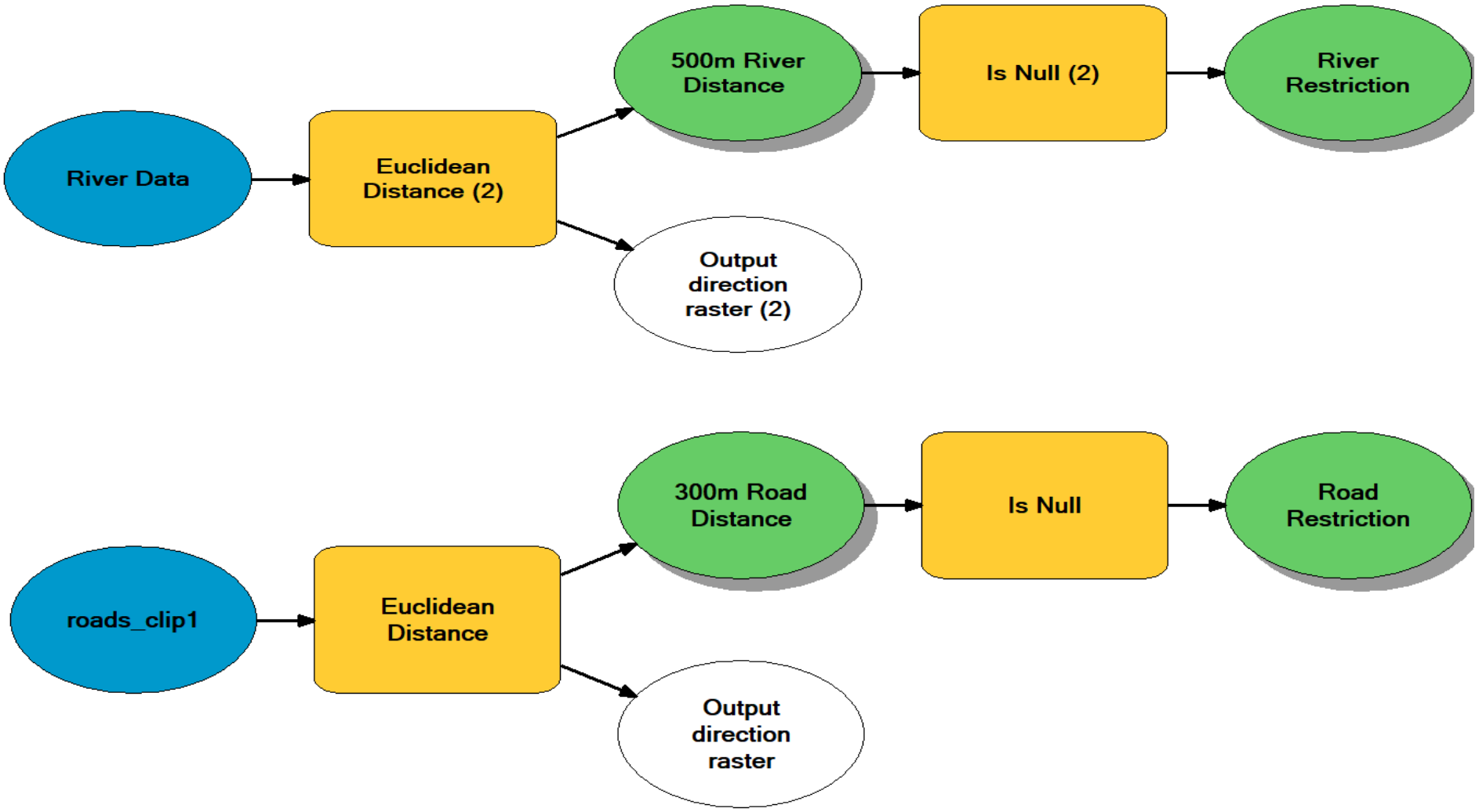

Fig 5b Site Screening Models for Roads, Rivers and Similar Line-based Criteria

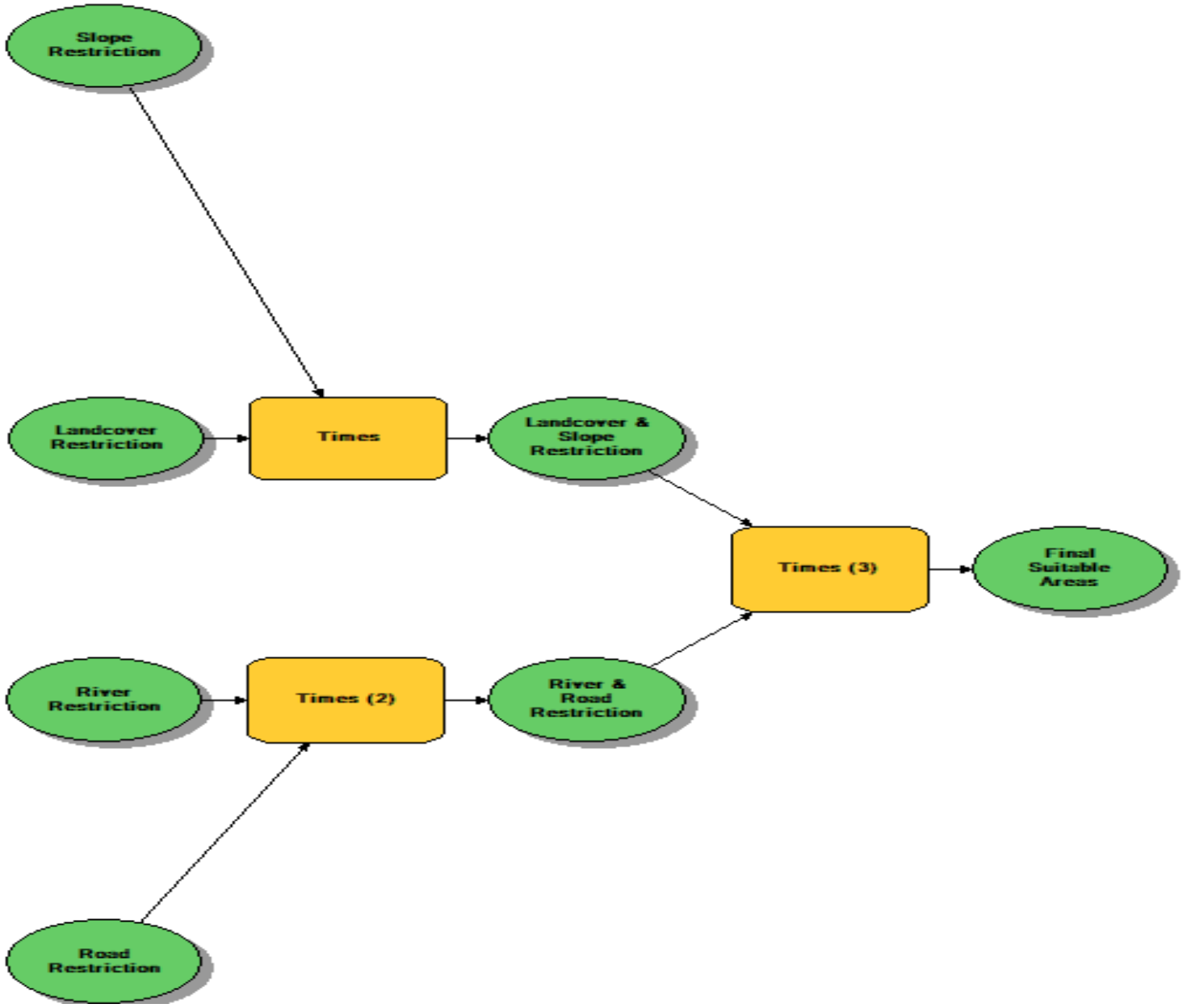

Fig 5c Integrated Site Screening Model for Mixed Classes of Feature-based Criteria

RESULTS AND DISCUSSIONS

Criterion Maps Generation

Using the constraint factors and their associated data, 7 criterion map layers were generated from the spatial database, using the methods and models described above. Examples of these are shown at Fig. 6a, Fig. 6b and Fig. 6c

Generation of Permissible Areas from All Restrictions

The composite models at Fig 5c were used to generate resultant maps showing the permissible areas based on groups or all of the restriction criteria. The Times tool in ArcGIS Spatial Analyst within the model builder was applied in this. Fig. 7 shows example of these results.

Application of Public/Community Views

Table 2 shows examples of the results of public/community opposition and acceptance survey. The final map of permissible areas (Fig. 7) may be used along with such community opposition information to evaluate the relative suitabilities of the sites and rule out areas of high community opposition risk.

Results and Discussions

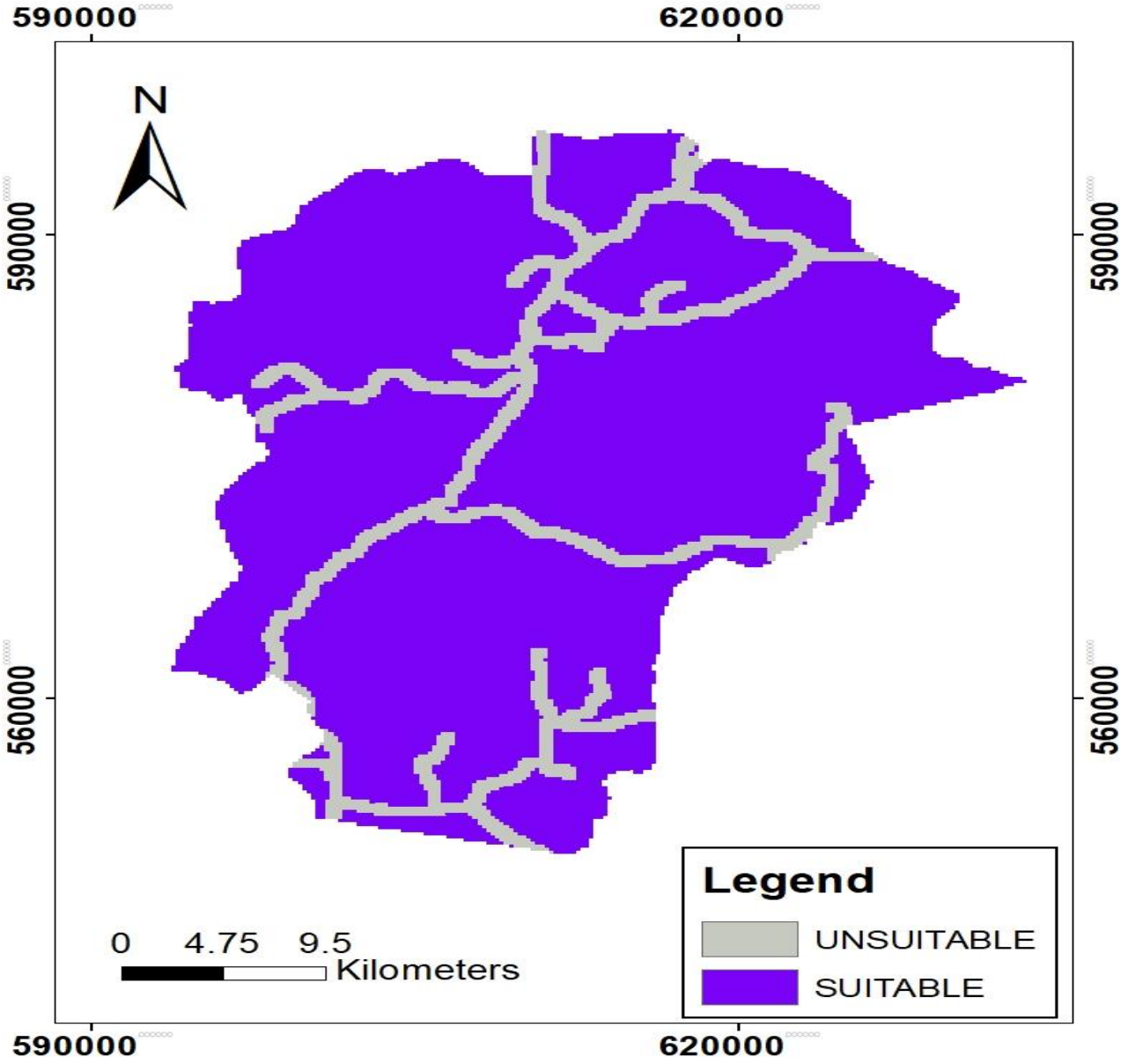

Fig 6a Map of Permissible Sites Based on Road Criteria

Results and Discussions

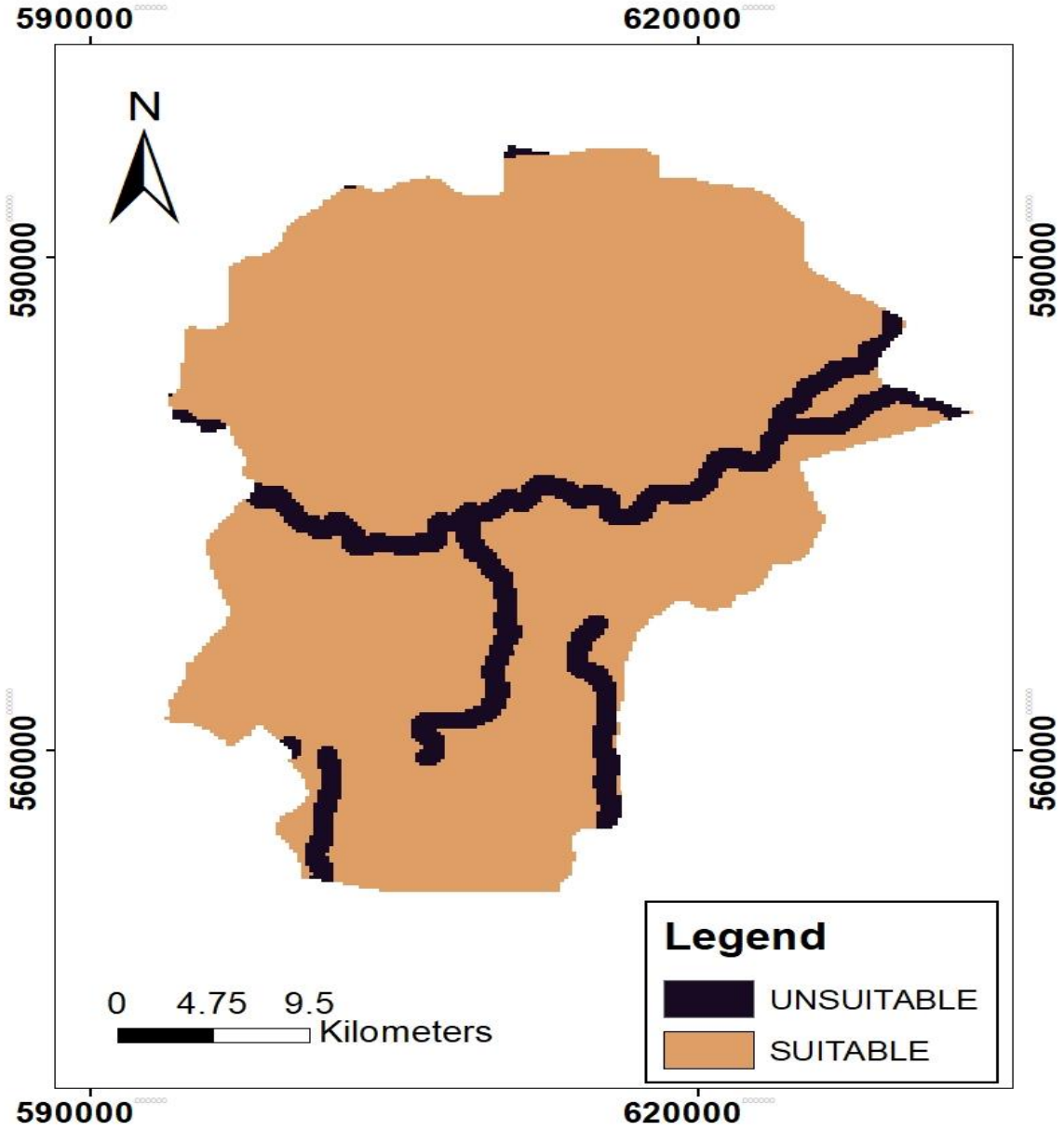

Fig. 6b Map of Permissible Sites Based on Surface Water Criteria

Results and Discussions

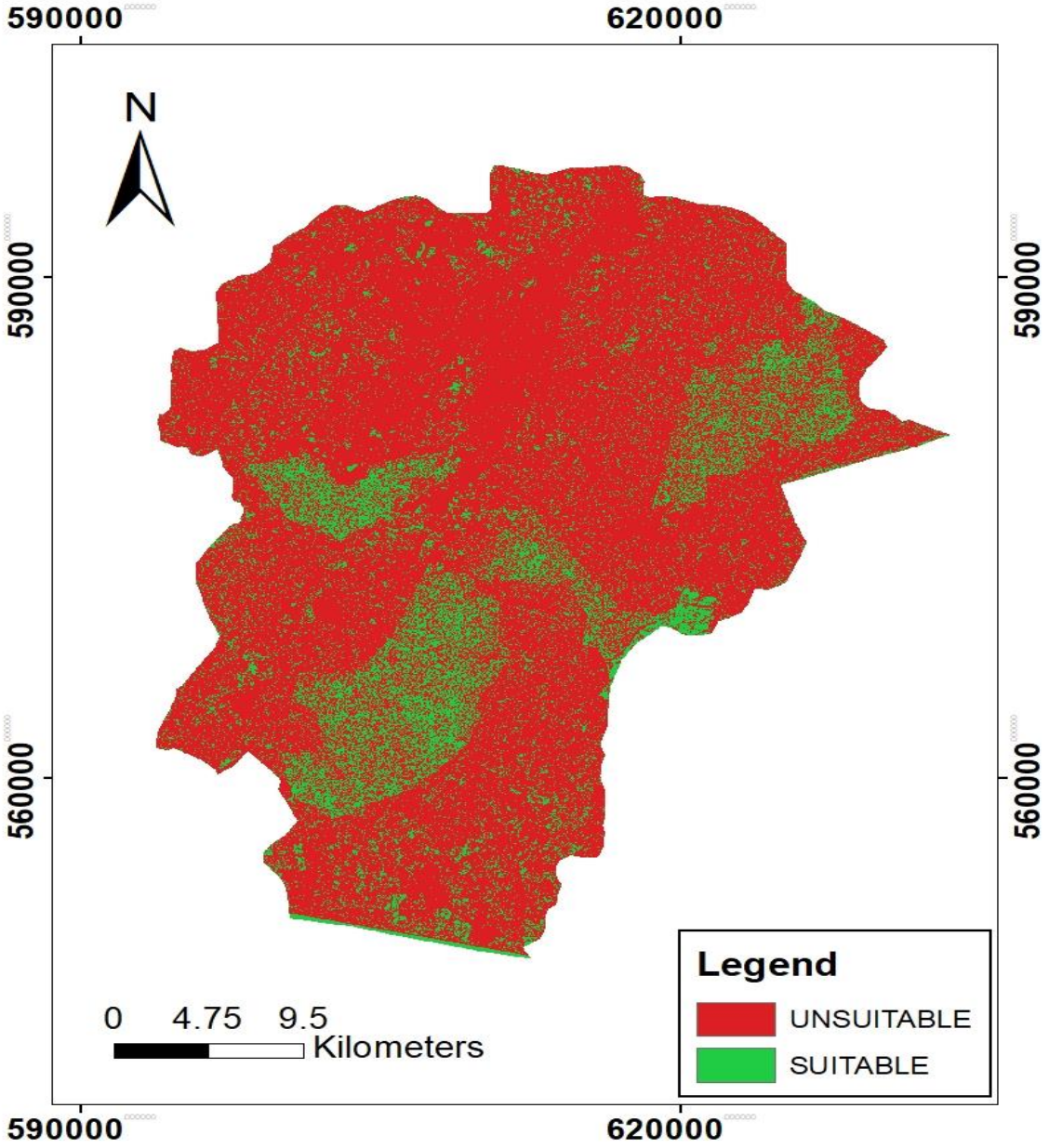

Fig. 6c Map of Permissible Sites Based on Slope Criteria

Results and Discussions

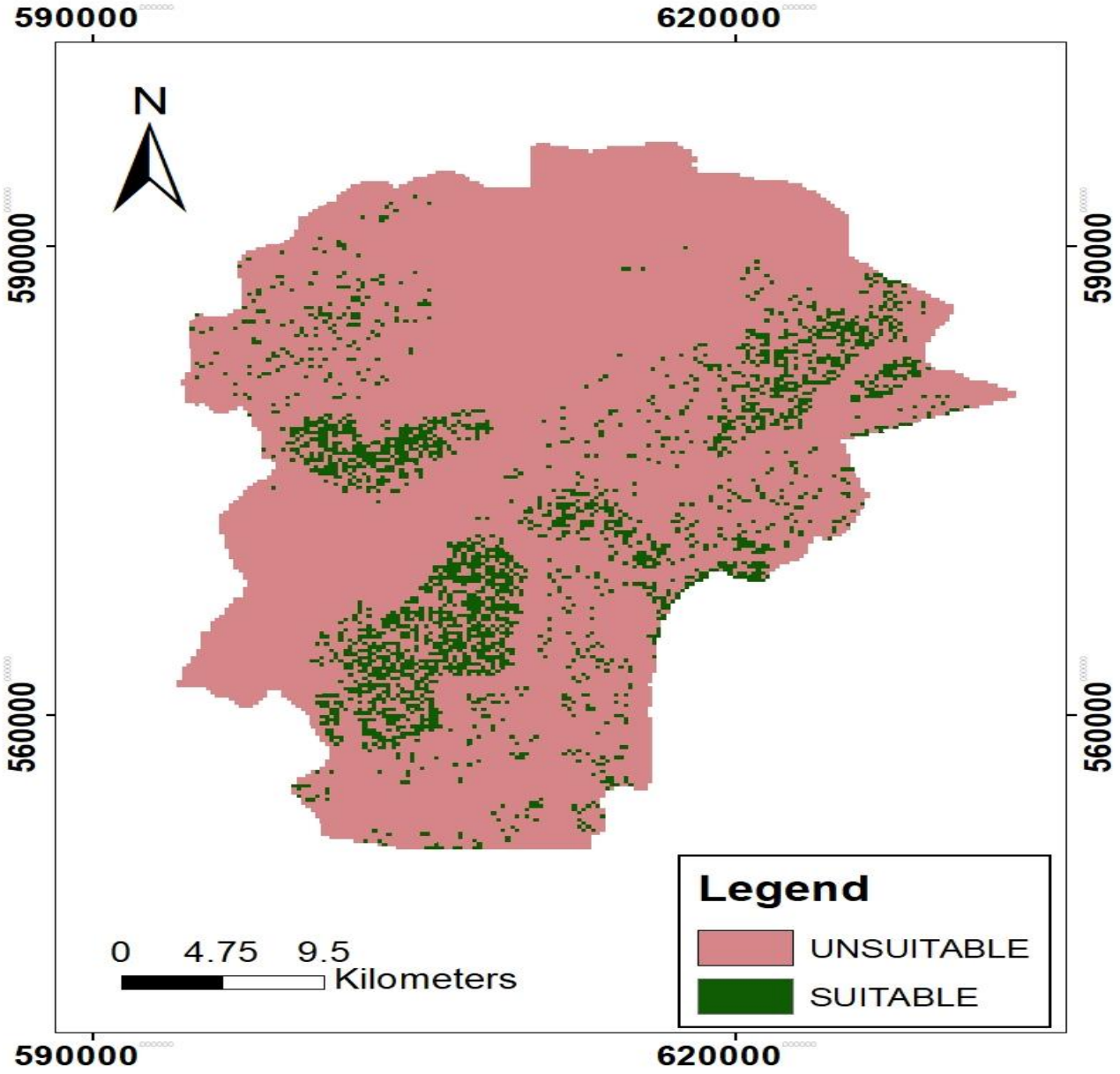

Fig. 7 Map of Permissible Sites Based on All Criteria Used

Results and Discussions

Table 2 Community Opposition/Acceptance Survey Results

Community Name /ID	Demographic Background	Level of Opposition	Level of *Acceptance	Main Reasons for Opposition
COM 1	AR: 18-80 years NM = 23 NF = 38	31%	69%	Negative Impacts of landfills
COM 2	AR: 20-70 years NM = 66 NF = 46	64%	36%	*Mistrust
COM 3	AR: 18-80 years NM = 38 NF = 42	55%	45%	*Mistrust
COM 4	AR: 18-75 years NM = 43 NF = 29	71%	29%	*Social & Environmental Injustice
COM 5	AR: 20-80 years NM = 28 NF = 22	60%	40%	Negative Impacts of landfills

NB:
AR = *Age Range of Respondents*; NM = *No. of Male Respondents*; NF = *No. of Females Respondents*;

*__Mistrust__ = *mistrust in Government, Public in Waste Management Officials to adequately protect human health and the environment from waste pollution;*
*__Social & Environmental Injustice__ = *perceived unfairness in the distribution of social amenities and environmental burdens.*

__*Acceptance__ = *acceptance to host municipal landfill with free communal waste collection as incentive and a promise to protect host community from the nuisance of the landfill*

CONCLUSIONS/RECOMMENDATIONS

- **Study/paper has demonstrated how " SMSA" MCDA and "POS" may be used to meet regulatory requirements in the identification of Permissible Sites for waste disposal at the local Level and how potential host community opposition may be taken into account.**

- **Methods used in this study may be adopted by local municipal authorities to improve public/community involvement and confidence in the selection and use of suitable sites for landfilling.**

- **Opposition/acceptance levels of host communities should be assessed and taken into account at the site selection stage before the acquisition process begins.**

END OF PRESENTATION

THANK YOU

CONTRIBUTIONS/SUGGESTIONS?