

A* FLOOD ROUTING SYSTEM

Smart Navigation with Real-Time Flood Avoidance

MALOLOS CITY, BULACAN, PHILIPPINES

Report Generated: December 01, 2025 at 04:18 AM

ROUTE INFORMATION

START: Malolos City Hall

F. Llamas Street, Brgy. Sto. Niño, Malolos City

END: Bulacan State University (Main Campus)

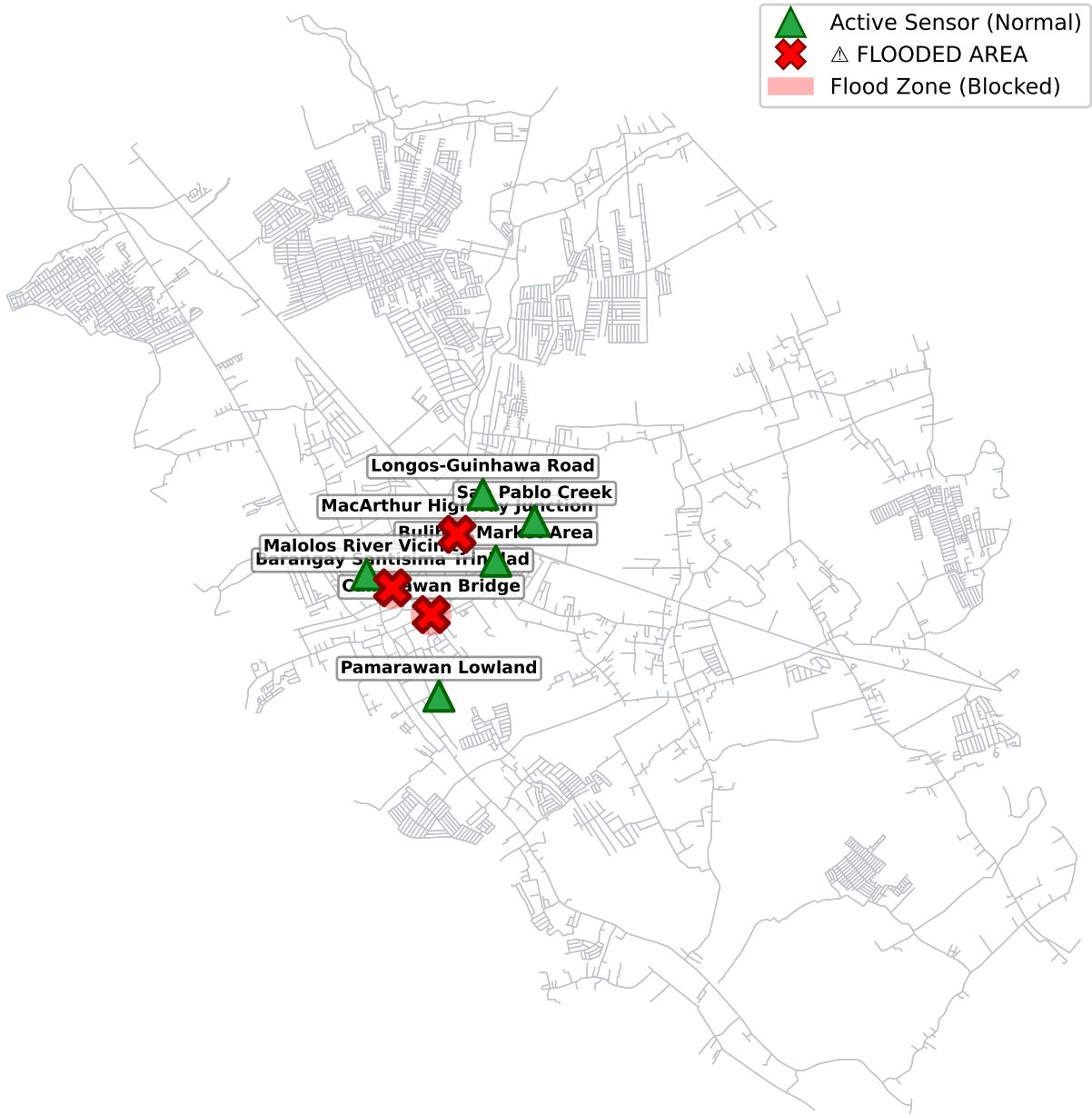
MacArthur Highway, Brgy. Guinhawa, Malolos City

SYSTEM FEATURES:

- ✓ Real OpenStreetMap road data
- ✓ Respects one-way streets
- ✓ A* optimal pathfinding
- ✓ Real-time flood detection
- ✓ Smart rerouting algorithm
- ✓ Turn-by-turn directions

FLOOD SENSOR NETWORK - Malolos City, Bulacan

(Strategic Monitoring Points)



⚠ FLOOD SENSOR STATUS REPORT

Real-time monitoring of strategic flood-prone locations

ID	SENSOR LOCATION	COORDINATES	STATUS
00	Barangay Santisima Trinidad	(14.8470°N, 120.8120°E)	⚠ FLOODED
01	MacArthur Highway Junction	(14.8510°N, 120.8170°E)	⚠ FLOODED
02	Bulihan Market Area	(14.8490°N, 120.8200°E)	⚠ Normal
03	Pamarawan Lowland	(14.8389°N, 120.8156°E)	⚠ Normal
04	San Pablo Creek	(14.8520°N, 120.8230°E)	⚠ Normal
05	Caliligawan Bridge	(14.8450°N, 120.8150°E)	⚠ FLOODED
06	Longos-Guinawa Road	(14.8540°N, 120.8190°E)	⚠ Normal
07	Malolos River Vicinity	(14.8480°N, 120.8100°E)	⚠ Normal

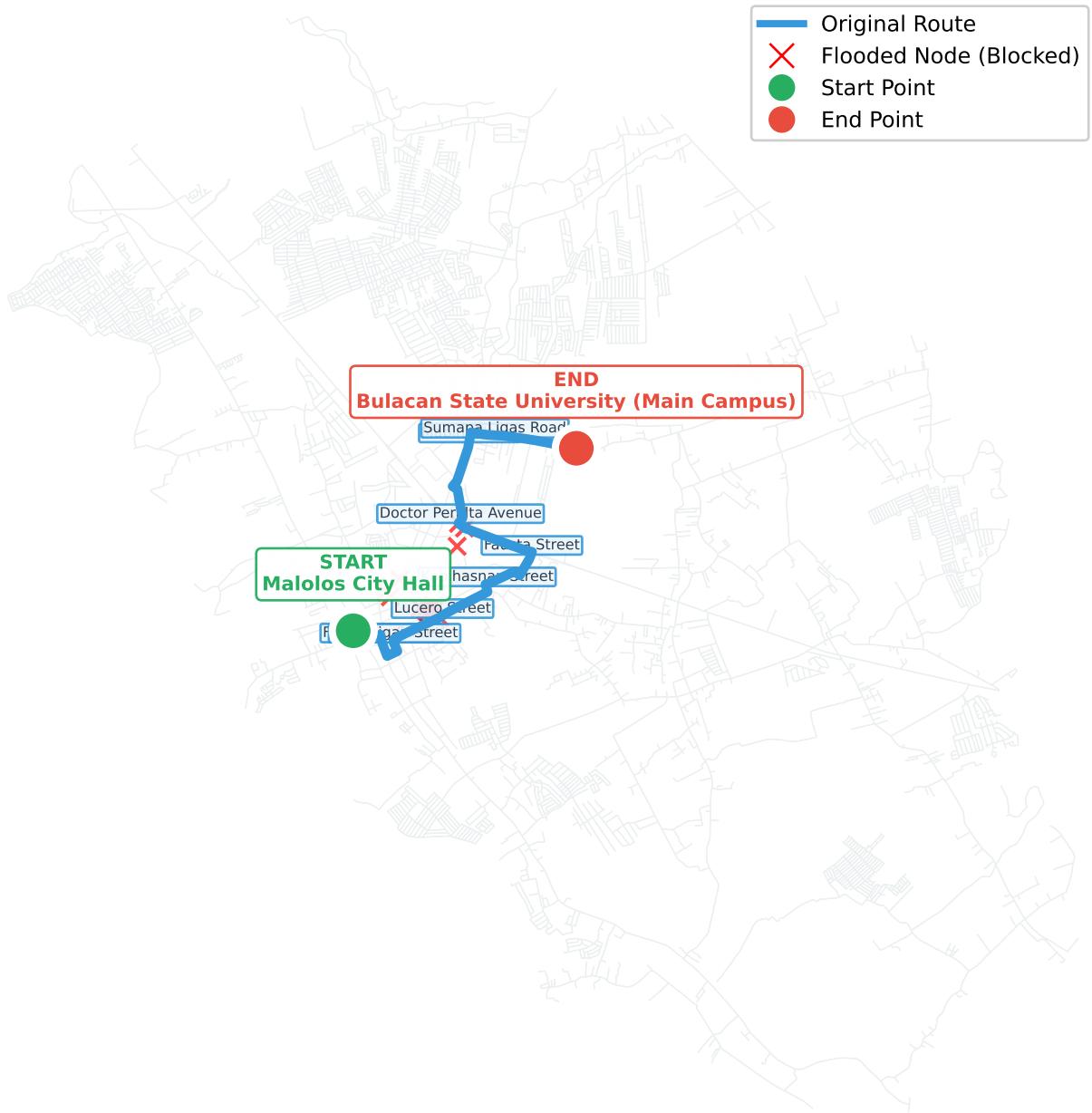
⚠ FLOOD ALERT SUMMARY

Active Sensors: 5

Flooded Areas: 3

ORIGINAL ROUTE (Without Flood Consideration)

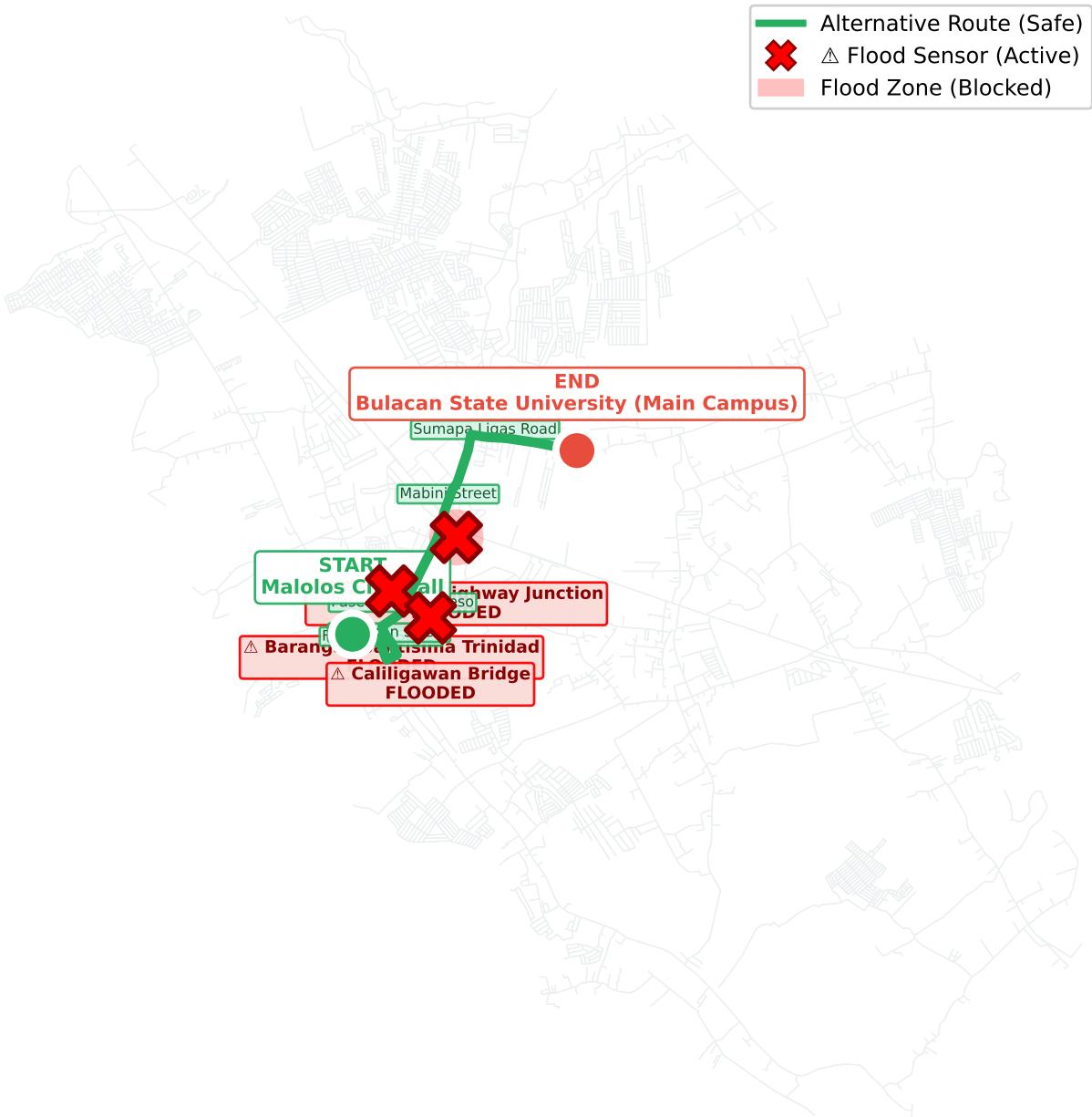
Malolos City Hall → Bulacan State University (Main Campus)



Distance: 4.64 km | Travel Time: 8.0 minutes

ALTERNATIVE ROUTE (Avoiding Flood Zones)

Malolos City Hall → Bulacan State University (Main Campus)



Distance: 3.56 km | Travel Time: 4.7 minutes

ROUTE COMPARISON: Original vs Alternative (Side-by-Side Analysis)



▢ TURN-BY-TURN DIRECTIONS

▢ RECOMMENDED ROUTE (Flood-Free):

- | | | |
|----|---|----------|
| 1. | Start on Unnamed Road | 98 m ↔ |
| 2. | Turn right Pariancillo Street | 218 m → |
| 3. | Turn left F. Estrella Street | 189 m → |
| 4. | Turn left T. Alonzo Street | 95 m → |
| 5. | Continue straight Canlapan Street | 181 m → |
| 6. | Continue straight Paseo del Congreso | 1.2 km ↔ |
| 7. | Turn right Mabini Street | 724 m ↔ |
| 8. | Arrive at destination via Sumapa Ligas Road | 890 m ↔ |

▢ ROADS ON ALTERNATIVE ROUTE:

Pariancillo Street, F. Estrella Street, T. Alonzo Street, Canlapan Street, Paseo del Congreso, Mabini Street, Sumapa Ligas Road

⚠ ORIGINAL ROUTE (May Pass Through Flood):

- | | | |
|----|--|-------|
| 1. | Start on Unnamed Road | 98 m |
| 2. | Turn right Pariancillo Street | 218 m |
| 3. | Turn left F. Estrella Street | 189 m |
| 4. | Turn left T. Alonzo Street | 95 m |
| 5. | Turn right Canlapan Street | 81 m |
| 6. | Turn left Unnamed Road | 19 m |
| 7. | Turn right Pagsibigan Street | 22 m |
| 8. | Continue straight M. Crisostomo Street | 381 m |

▢ ROADS ON ORIGINAL ROUTE:

Pariancillo Street, F. Estrella Street, T. Alonzo Street, Canlapan Street, Pagsibigan Street, M. Crisostomo Street, Lucero Street, Kabihasnan Street, Paraluman Street, Fausta Street

ROUTE ANALYSIS SUMMARY

ORIGINAL ROUTE

Distance: 4.64 km

Travel Time: 8.0 min

Nodes: 57

⚠ BLOCKED BY FLOOD

ALTERNATIVE ROUTE

Distance: 3.56 km

Travel Time: 4.7 min

Nodes: 50

SAFE & RECOMMENDED

ROUTE DIFFERENCE

Distance: -1.08 km (-23.2%)

Time: -3.3 minutes

RECOMMENDATION

Take the ALTERNATIVE ROUTE to safely avoid all flood-affected areas.

☐ A* ALGORITHM TECHNICAL DETAILS

THE A* PATHFINDING ALGORITHM

A* finds the shortest path using the formula: $f(n) = g(n) + h(n)$

Where:

- $f(n)$ = Total estimated cost of path through node n
- $g(n)$ = Actual cost from start to node n
- $h(n)$ = Heuristic estimate from n to goal

IMPLEMENTATION FEATURES:

1. REAL ROAD NETWORK DATA

- Source: OpenStreetMap (© OpenStreetMap contributors)
- Respects one-way streets and turn restrictions
- Includes all road types: highways, primary, secondary, residential

2. HEURISTIC FUNCTION

- Uses Haversine formula for great-circle distance
- Admissible heuristic (never overestimates)
- Guarantees optimal path finding

3. FLOOD AVOIDANCE MECHANISM

- Sensors detect flooding at strategic locations
- Nodes within flood radius are marked as impassable
- A* excludes flooded nodes from pathfinding
- Real-time rerouting when floods detected

4. TRAVEL TIME ESTIMATION

- Based on road type and speed limits
- Considers road length and conditions
- Factors in traffic characteristics

DATA SOURCES & REFERENCES:

- Road Network: OpenStreetMap via OSMnx library
- Coordinate System: WGS84 (EPSG:4326)
- Flood Sensors: Simulated at known flood-prone areas