For discussion
on 16 May 2025

Legislative Council Panel on Transport
Action plan to enhance the maintenance strategies of public roads

Purpose

This paper briefs Members on the Highways Department (HyD)'s public roads maintenance strategies enhancement plan.

Background

2. HyD is responsible for the repair and maintenance of about 6 600 kilometres (km) of public carriageways in Hong Kong, of which about 1 500 km are high-speed carriageways with speed limit of 70 km per hour or above. HyD ensures the safety and reliability of the public road network through regular road inspection mechanism by engaging contractors to carry out the relevant work under term contracts. When damage to road surfaces is identified during inspections or damages to roads and ancillary road facilities are reported by the public, HyD would arrange contractors to carry out repair works as soon as possible to defects that may pose hazard to road users. According to records of HyD, in the past two years, all repair works of potholes were completed within 24 hours upon receipt of reports, meeting HyD's performance pledge[1]. For defects that do not pose immediate danger to road safety, HyD would formulate appropriate repair plan and schedule for such defects having regard to various factors, such as arranging road resurfacing at a timely juncture.

[1] According to HyD's performance pledge, HyD will complete all repair works of potholes within 48 hours upon receipt of reports.

Challenges in road maintenance

3. Repairing and maintaining roads in densely developed Hong Kong faces a number of challenges, including –

(i) Accelerated rate of road deterioration – Various factors such as ageing of roads, increasing traffic volume, rapid growth in the number of heavier electric vehicles, more frequent occurrences of extreme weather and severe rainfall in parts of the territory, dense and ageing underground utilities etc. result in accelerated road deterioration.

(ii) Considerable growth in public road network – The length of the public carriageways repaired and maintained by HyD has increased by about 490 km (growth of about 8%) over the past decade. With the completion of new projects such as the Tung Chung New Town Extension, development at Anderson Road, the Central Kowloon Route and the Northern Metropolis in the future, it is expected that road inspection, repair and maintenance work will continue to grow at a high level.

(iii) Labour shortage and ageing – The high level of growth in road inspection, repair and maintenance work will put pressure on the related manpower demand. However, with the ongoing overall shortage of labour in the construction industry, as well as reduced productivity industry-wide due to the ageing of construction workers, the progress of road inspection, repair and maintenance work will inevitably be affected.

(iv) Difficulties in implementing temporary traffic arrangement – Considering that increase in traffic volume in the future will increase the utilisation of roads, it will become more difficult to implement larger scale and longer-term temporary traffic arrangements for road maintenance on damaged roads. At present, in the absence of compatible alternative routes for many of the damaged main roads, HyD can only carry out short and medium-term road repair works on a smaller scale on those roads to avoid serious disruption to traffic in their vicinity. To implement road maintenance works of a larger

scale often requires longer period for public consultation and preparation of temporary traffic arrangement schemes. Details on traffic impact of different scales of road repair works are shown at **Annex 1**.

Action plan to enhance the maintenance strategies of public roads

4. As Hong Kong's economy grows, transport needs and public expectation on road conditions are also on the rise. It is therefore important to overcome the above challenges in road maintenance to ensure reliability of the public road network, safeguard the safety of the public in their commuting as well as enhance the comfort of road users.

5. In this connection, HyD established the Strategic Road Maintenance Committee led by the Deputy Director of Highways in March 2025. Representatives from relevant departments, including the Hong Kong Police Force, Transport Department, Environmental Protection Department and Home Affairs Department, have been invited to join the Committee to advise and assist in the maintenance of public roads. The work of the Committee includes compiling a list of roads that require major maintenance, prioritising maintenance works based on various factors such as the extent of damage to each section of the road and the resources required for the repair works, jointly reviewing the scheme of each road maintenance project and overseeing the projects, exploring the introduction of new materials and technologies for road maintenance, and assisting the maintenance teams to obtain road closure permits and commence the road repair works as soon as possible through collaboration.

6. Regarding road inspection and repair works, HyD will strive to adopt innovative technologies to enhance the efficiency of road repair and maintenance services and reduce manpower. In addition, HyD will actively explore the use of more durable paving materials to slow down the rate of road deterioration and even reduce the frequency of repair works, while minimising inconvenience to the public. HyD will also work with relevant departments to formulate temporary traffic measures to overcome the challenges of implementing temporary traffic arrangements. This will facilitate the orderly implementation of larger-scale road maintenance

works at heavily trafficked road sections, such as Lung Cheung Road and Canal Road Flyover, with a view to enhancing the maintenance efficiency and improving the driving comfort. Details of the specific strategies adopted by HyD are set out in the ensuing paragraphs.

Strategy 1: Enhance maintenance efficiency by adopting innovative technologies and promoting digitalisation in management

7. HyD adopts innovative technologies and promotes management digitalisation to enhance the efficiency and reduce manpower in road maintenance and repair services. Specific examples include –

(i) Vehicle-borne ground penetration radar

More serious road subsidence is typically linked to damage to underground pipeline facilities (such as watermains and sewers) or improper handling of foundation works at adjacent roads (especially those involving deep excavation and lowering of groundwater levels), as these would lead to soil loss from the road base and formation of underground voids. When vehicles pass over those voids, there is a chance that the road surface will subside. In addition, if the filling materials are not properly backfilled and compacted after road excavation, the road surface may subside as a result of settlement of the underlying soil after vehicles have driven over it. To proactively prevent road subsidence incidents, HyD is currently studying the use of the vehicle-borne ground penetration radar for non-excavation inspection of underground conditions of roads, so as to identify suspicious underground conditions early and promptly deal with potential cases as soon as possible. As the technology does not require road closure or excavation when detecting underground conditions, it can significantly minimise the impact on traffic, making it particularly suitable for use on Hong Kong's busy roads. The above trials already commenced progressively in the first quarter of 2025 on busier or higher-risk roads. We will assess the practicality, accuracy, technical constraints and cost-effectiveness etc. of this technology following the trials, and review the feasibility of its wider application afterwards.

(ii) Use of artificial intelligence in Road Defect Detection System (RDDS)

In the past, routine road inspections needed to rely on visual inspection by road inspectors to identify road defects such as cracks in the road surface and discoloured road markings. Even though the inspectors have professional knowledge and extensive experience, the judgement of different road inspectors may vary. This type of inspection method also makes it difficult to accurately record the location of road defects, and maintenance personnel need to spend time on site to search for the precise defect location before they can commence the maintenance works. In this regard, HyD has developed the RDDS to enhance the accuracy of recording defective locations and improve the efficiency of road maintenance.

The RDDS uses high-definition cameras installed on patrol vehicles to capture images of road conditions, and employs global satellite positioning technology to record the locations of such images. It then uses artificial intelligence technology to automatically identify road surface cracks and discoloured road markings, instead of relying on the visual inspection by road inspectors as in the past to ensure that the detection results are objective and accurate. Contractors use inspection patrol vehicles equipped with RDDS (see **Annex 2**) to carry out comprehensive inspection of all roads in Hong Kong once every three months. The detection results of road defects will be displayed on a web-based maintenance platform equipped with geographic information system maps, to facilitate maintenance personnel to locate the defects and carry out repair works. Moreover, RDDS can consolidate relevant information into defect reports for maintenance personnel to record and audit the maintenance status. With enhanced inspection accuracy and maintenance records, the required maintenance works can be completed more swiftly and efficiently.

(iii) Use of laser scanning for three-dimensional imaging in Road Condition Assessment System (RCAS)

The RCAS uses patrol vehicles equipped with laser scanning equipment and global satellite positioning technology to drive on a carriageway at normal speed, and can automatically identify and accurately record various types of defects on the road surface such as potholes, rutting etc. (see **Annex 3**). It also calculates a Pavement Condition Index for every 100 metres of the road for the reference of colleagues responsible for maintenance to determine whether the section of road should be prioritised for reconstruction or resurfacing works. At the present trial stage, RCAS is capable of inspecting about 200 km of carriageways per day. Compared to the past when road inspectors had to conduct visual inspection and measurement on the road surface after making road closure arrangements, which only covered a few hundred meters of carriageways per day at most, RCAS enables the maintenance team to have a more comprehensive grasp of the latest conditions of all road surfaces without the need for road closures. This allows for more effective use of resources when planning road maintenance works, and also helps avoid disruption to traffic.

At present, RCAS has been put on trial in some road maintenance contracts. HyD plans to take one year to inspect all the carriageways under its maintenance across Hong Kong. According to preliminary estimation, the introduction of RCAS would be able to free up about one-fourth of the manpower of the contractors' road inspection teams to cope with the increasing demand for road maintenance work. HyD is now evaluating the effectiveness of RCAS and will consider in due course the full-scale application of the technology and its incorporation into the standard operating procedures for future road inspections.

(iv) Electronic Road Maintenance Monitoring System (RMMS)

RMMS is a system that fully digitalises the monitoring and administration of road maintenance work. In the past, whenever HyD's staff identified defects in road facilities during inspection, they were required to fill in and send the relevant physical form to the contractors upon completion of the inspections. With the RMMS, staff can now log on to the system during outdoor inspections and electronically notify the contractors of the information on damage to facilities captured on-site, so that contractors can receive the relevant data promptly and arrange for repair works accordingly. After completion of repair works, contractors can also use RMMS to report the work done and submit maintenance records. The use of RMMS therefore cuts down on complicated paperwork and enhances work efficiency, facilitating HyD's staff to monitor the progress of maintenance more effectively and perform better maintenance record keeping.

At present, RMMS has been used in all road maintenance contracts. Full adoption of RMMS not only effectively enhances work efficiency, but also reduces paper usage. HyD is now developing the second phase of RMMS, which will incorporate more monitoring and management functions, such as automatic alerts or warnings to contractors with unsatisfactory maintenance progress, as well as digitalised checking procedures.

(v) Automatic tunnel inspection equipment

At present, HyD is responsible for the repair and maintenance of 21 tunnels across Hong Kong. Depending on the scale of individual tunnels and the surrounding environment, the maintenance work faces different constraints, such as narrow ducts, confined spaces, uneven road surface etc., rendering it not always possible to find fully suitable inspection tools at a reasonable price in the market. Therefore, HyD works in collaboration with maintenance staff or contractors to independently develop or modify suitable automatic inspection equipment for individual tunnels. For example, the inspection

vehicle used in the overhead ventilation duct of Scenic Hill Tunnel (see **Annex 4**) has been equipped with cameras at different angles, and has its wheels suitably modified to accommodate the road surface conditions of the ventilation duct.

(vi) Small unmanned aircraft (SUA)

One of the major advantages of SUA is that they can effectively acquire high-definition images and videos footages conveniently and safely of structures that were previously difficult to be accessed by inspectors, such as bridge towers, exterior walls and underpasses of bridges across the sea or with busy carriageways. This can aide inspection engineers in accurately and comprehensively assessing the condition of the structures and making corresponding records for close monitoring of the structural conditions as well as planning for future maintenance work. SUA, when equipped with mapping functions, can also quickly generate three-dimensional model of structure for emergency documentation and surveying to support emergency repair works. HyD has already formed a SUA team and obtained necessary pilot licences to carry out structural inspections of road structures and slopes at any time.

Strategy 2: Adoption of new materials for maintenance works

8. The research and application of new materials can enhance the performance and durability of road pavement materials. By adopting better materials to slow down the rate of deterioration of road surfaces, we can effectively cope with the accelerated rate of deterioration of road surfaces caused by different factors. Examples of new materials being used or developed by HyD include –

(i) Development of more durable bituminous paving materials

HyD continues to develop and introduce bituminous materials with higher durability for road pavement. In collaboration with the Hong Kong Polytechnic University (PolyU), HyD developed a new type of highly modified bituminous paving material, namely

"10 millimetre (mm) Highly Modified Stone Mastic Asphalt (HMSMA10)", which is more durable and adopts a modified bitumen binder that is more resistant to high temperatures. Laboratory test results and site trials revealed that this material has better anti-deformation, anti-ageing and anti-fatigue performance than conventional bitumen. It is approximately 30%[2] more durable than the latter, and hence can effectively enhance the durability of road surface and reduce the frequency of maintenance.

(ii) Development of new low noise road surfacing (LNRS) material

Apart from enhancing durability, HyD has also been proactively improving road surfacing materials that can help reduce traffic noise. HyD has earlier collaborated with the PolyU to develop a new LNRS material suitable for use on Hong Kong's urban roads, namely "6mm Highly Modified Stone Mastic Asphalt (HMSMA6)", which can reduce road-tire noise by approximately 2.5 dB(A), equivalent to a reduction of nearly half of the perceived noise experienced by traffic volume. Compared with the existing LNRS materials, the new material also has better performance in rutting resistance, is more durable and also more sustainable.

(iii) Development of highly permeable pavement material for high speed roads

As regards the surfacing material of high speed roads, HyD specifically uses highly permeable porous friction course materials to facilitate the rapid drainage of rainwater, thereby reducing the likelihood of traffic accidents caused by slippery road surface. To further enhance its durability, HyD has collaborated with PolyU to develop a new highly modified bituminous paving material, namely "Highly Modified Friction Course". Based on computer simulation, this material is more durable than

[2] The actual durability of the material will be affected by a number of on-site factors such as traffic flow, vehicle speed, and application locations (e.g. bus stops, stop lines or sharp bends) etc.

conventional porous friction course materials by approximately 7%[3]. On the other hand, laboratory test results have shown that this material outperforms the existing conventional bitumen in terms of resistance to deformation, ageing and fatigue, while retaining its ability to rapidly discharge rainwater from the road surface. Furthermore, this material can reduce road-tire noise generated by vehicle wheels running over the road surface, making road environment quieter, which is very suitable for paving on high speed roads.

9. Starting from 1 April 2025, HyD has fully adopted the above-mentioned highly modified bituminous materials for paving at suitable locations to further enhance the overall quality of road pavements in Hong Kong. According to preliminary estimation by HyD, although the overall cost of using these new bituminous materials (including that of construction and maintenance) is slightly higher than that of conventional bituminous materials, the better durability of these new materials reduces the frequency of road maintenance and the inconvenience caused by road resurfacing works to the public, thereby lowering social costs. With the full adoption of highly modified bituminous materials under road maintenance contracts, its cost is expected to gradually decrease. HyD will continue to develop and introduce more durable bituminous materials for road paving to improve road pavement quality and reduce maintenance frequency in a more cost-effective manner, while creating a better driving environment for motorists.

10. HyD keeps abreast of the latest research, development, and practical applications of road pavement materials in the Mainland and overseas. For example, it has recently came to HyD's attention that an alternative surfacing material known as "semi-flexible pavement" [4] performs well under high traffic flow and heavy vehicle usage conditions in the Mainland. HyD is currently in collaboration with PolyU to examine the technical feasibility of applying this material at high-traffic

[3] The actual durability of the material will be affected by a number of on-site factors such as traffic volume, vehicle speed, and application locations on high speed roads etc.

[4] A pavement formed by grouting cement-based mortar into the porous bituminous materials.

road sections, intersections, and future smart and green mass transit systems in Hong Kong. The study is expected to be completed within 2025, after which HyD will arrange site trials based on the study findings.

11. In addition, HyD is in contact with experts in the Guangdong-Hong Kong-Macao Greater Bay Area to explore the feasibility of introducing ultra-high performance concrete (UHPC) materials to repair existing ageing concrete road pavements. It is expected that such UHPC materials could improve the durability and tensile strength of road surface under high traffic flow conditions. They could, at the same time, shorten the concrete curing time or construction time, thereby minimising the impact on traffic during the works period.

Strategy 3: Collaboration with other departments to expedite implementation of larger-scale road maintenance works

Centralised arrangement for implementation of larger-scale road maintenance works

12. At present, Urban Regional Office and the New Territories Regional Office of HyD are responsible for road maintenance works in their respective regions. When taking forward road maintenance works, regional offices need to consult various departments, including the Hong Kong Police Force, Transport Department, Environmental Protection Department and Home Affairs Department etc. on a case by case basis to formulate the temporary traffic arrangements and road maintenance works programme. However, as the implementation of large-scale road maintenance works has a relatively greater impact on the local community, there may be differences in the view of various departments on the temporary road closure measures or works programme for such works, thus the vetting and approval for the relevant temporary traffic arrangements and construction noise permits take a longer period of time. In view of the above, HyD seeks to review and prioritise large-scale road maintenance works in different districts through the Strategic Road Maintenance Committee mentioned in paragraph 5 above. The Committee will jointly formulate the most appropriate temporary traffic arrangements to speed up the approval process. HyD will also strategically arrange for works requiring prolonged temporary road closure to be carried out only during

long holidays or school holidays in order to minimise the impact on the public.

Coordination with other local works and seizing the opportunity of transport network development in taking forward maintenance works

13. In addition, HyD is planning to collaborate with other works departments to reduce the number of temporary traffic measures and road excavation by handing over the work sites to HyD after they have completed the replacement or maintenance works of underground utility (e.g. watermains replacement and drainage works) on heavily trafficked public roads without the need for temporary road resurfacing, such that HyD can seize the opportunity to resurface the road at those locations, thereby minimising the impact on the traffic and the public and creating synergy.

14. Apart from road maintenance works, HyD also strives to enhance the driving comfort on public roads. For example, after the commissioning of the Central Kowloon Route, HyD will review the traffic flow at Lung Cheung Road and assess whether it is feasible to implement long-term temporary traffic arrangements for converting the road surface of Lung Cheung Road from concrete to bitumen so as to enhance driving comfort and facilitate future maintenance works. HyD will also closely monitor the development of other transportation networks and seize the opportunity to carry out similar works.

Way forward

15. The Strategic Road Maintenance Committee of HyD will work to implement the aforementioned strategies and monitor their effectiveness. The Committee will also closely monitor the latest developments in road damage inspection and maintenance technologies, as well as the application of new road paving materials. In addition, HyD will strengthen collaboration with different departments to expedite maintenance works on roads with heavy traffic.

Advice sought

16. Members' views are welcome.

Transport and Logistic Bureau
Highways Department
May 2025

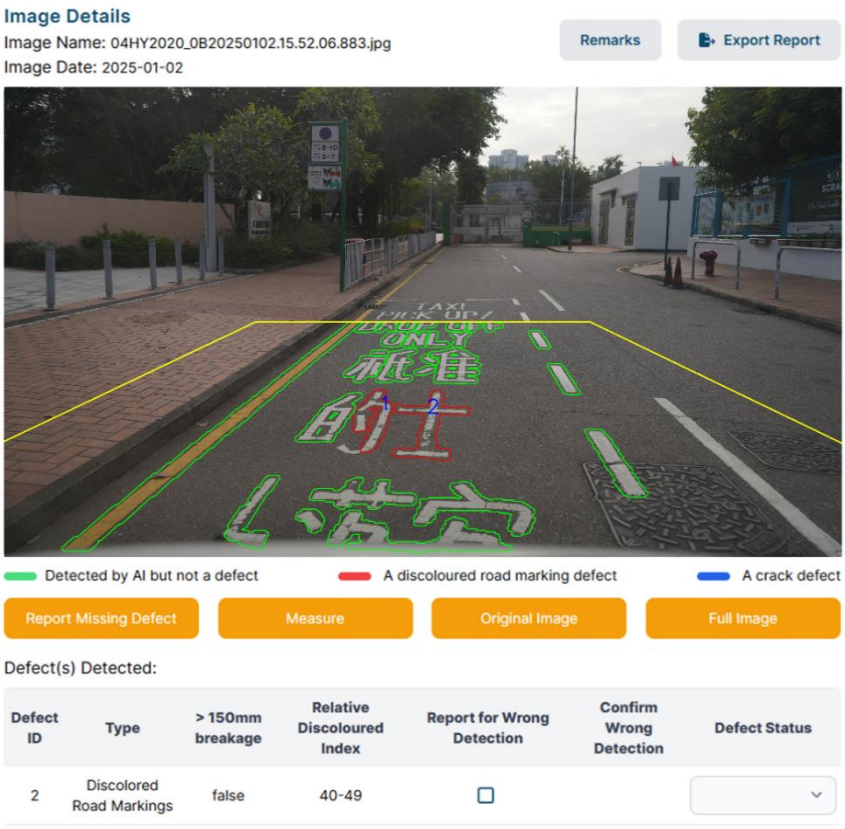
Annex 1

Details of road maintenance works of different scales

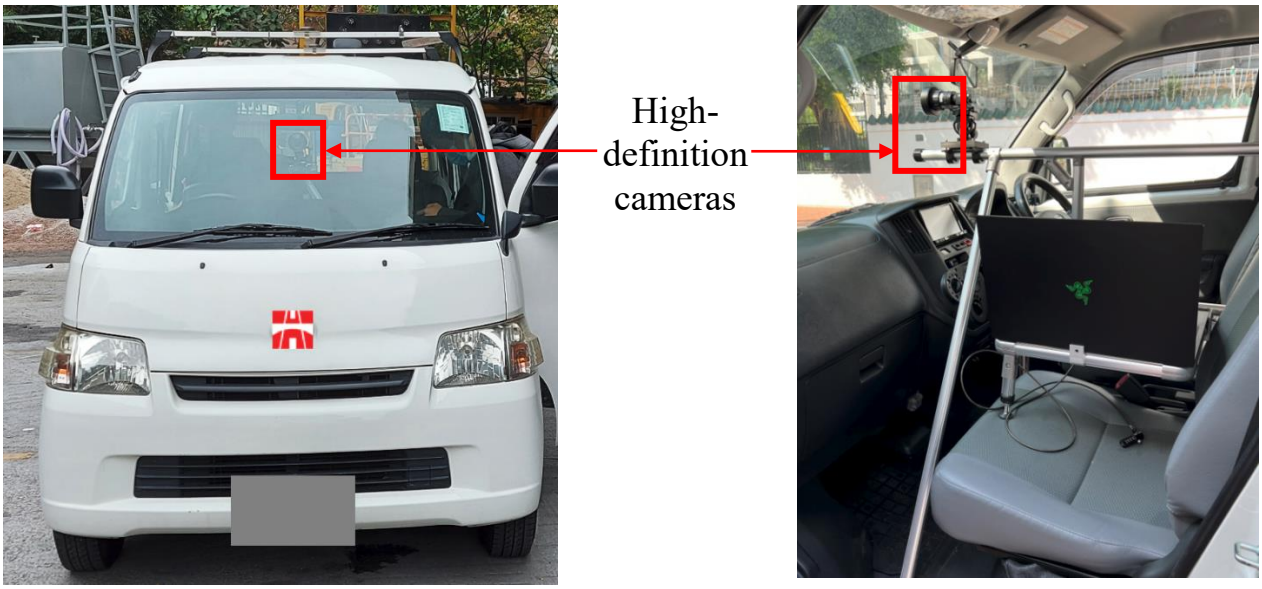
	Short-Term Road Maintenance Works	Medium-Term Road Maintenance Works	Long-Term Road Maintenance Works
Scope of works	➢ Small scale local road re-construction (i.e. within 20 square metres (m^2))	➢ Full lane resurfacing/ re-construction (i.e. >20m^2)	➢ Large scale full road re-construction
Works duration	➢ Takes 2 – 3 days	➢ Takes 1 – 2 weeks	➢ Takes more than 2 weeks with large-scale temporary traffic arrangements
Example of temporary traffic arrangement	➢ To be conducted during a weekend	➢ To be carried out in phases on weekends to maintain one traffic lane	➢ Require 24-hour closure of certain road lanes
Example of works	➢ Repairing damaged concrete pavement of Aberdeen Tunnel 	➢ Bituminous resurfacing works at Marble Road 	➢ Resurfacing works at Western Harbour Crossing (converting the road surface from concrete to bitumen) 

Annex 2

Use of artificial intelligence in Road Defect Detection System (RDDS)



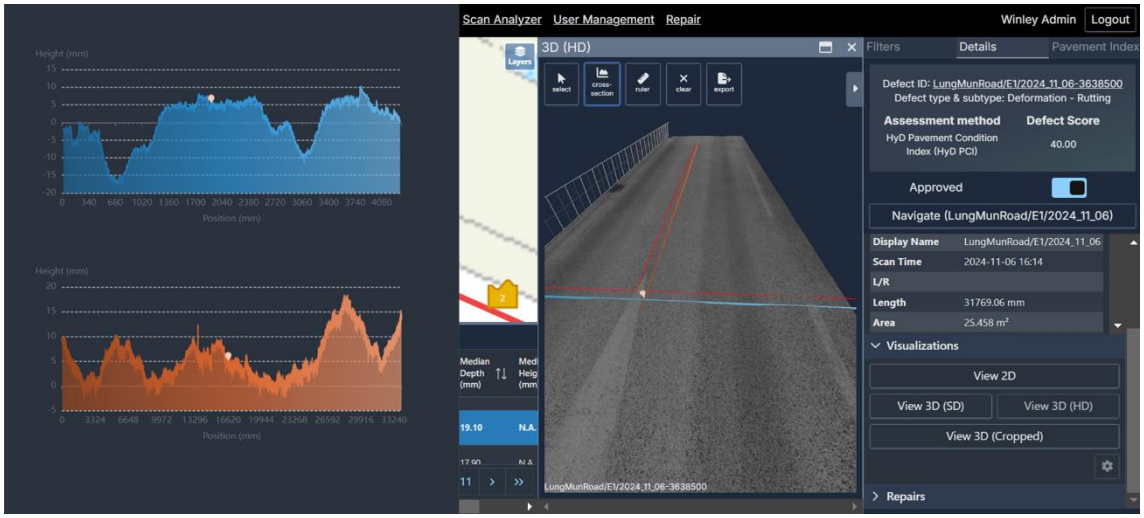
Network maintenance platform equipped with Geographic Information System map showing road defects



Patrol vehicles equipped with RDDS

Annex 3

Artificial intelligence and geometry analysis of three-dimensional profiles of road pavements by the Road Condition Assessment System (RCAS)



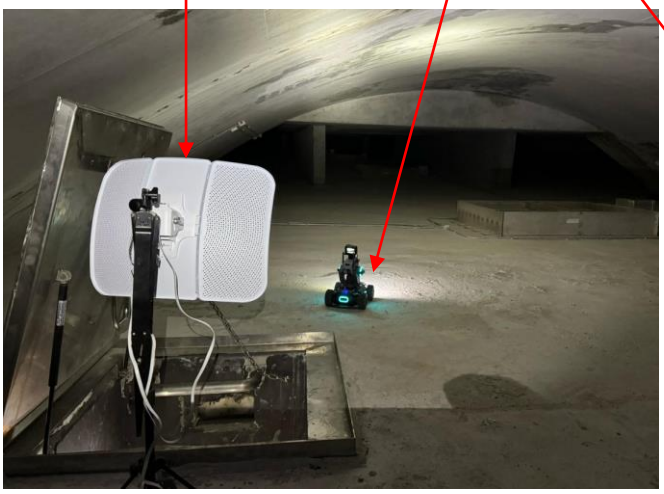
Road condition scanned and recorded on RCAS (example showing rutting)

Annex 4

Modified inspection vehicle used in overhead ventilation duct of Scenic Hill Tunnel

Additional WiFi repeater

High-intensity lighting



4K/50fps camera

3D-printed wheels to create larger diameter